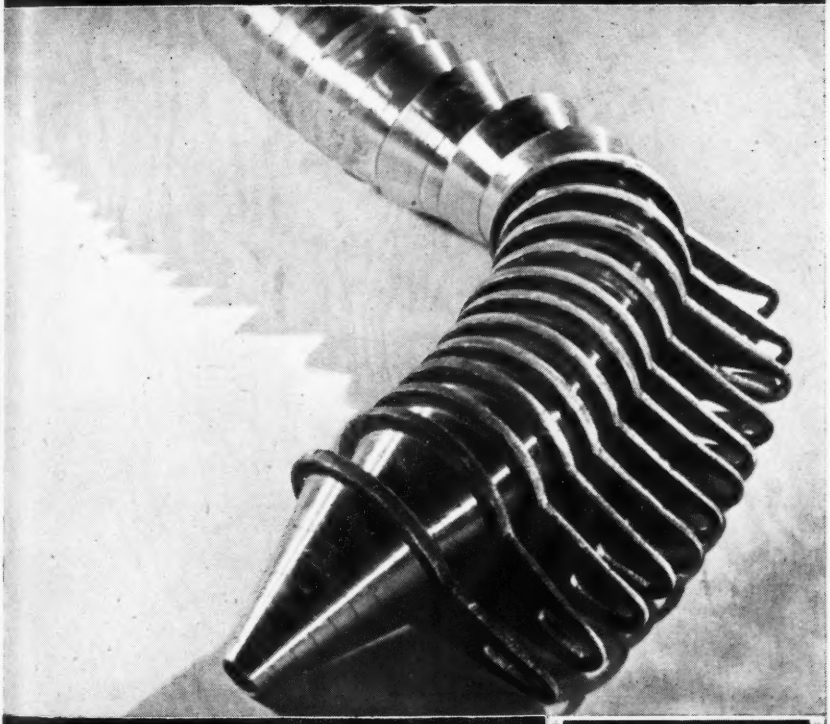
JAN 1 0 1944
RISING BUSBARS

ELECTRICAL REVIEW

FOUNDED 1872

VOL. CXXXIII. No. 3446 DECEMBER 10, 1943 6d. WEEKLY

Pattern of Industry: Documentary of work in progress No. 10



Like a mythological scaly serpent: cones for the Ellison clamp that ensure safe anchorage for armoured cables.

TRADE E MARK
GEORGE ELLISON
LIMITED
BIRMINGHAM 22B ENGLAND

470

Drums
BOILER DRUMS AND PRESSURE VESSELS ARE BETTER BABCOCK FUSION WELDED
BABCOCK & WILCOX LTD., BABCOCK HOUSE, FARRINGDON STREET, LONDON, E.C.4.

BOILER DRUMS AND PRESSURE VESSELS ARE BETTER BABCOCK WELDED
BABCOCK & WILCOX LTD., BABCOCK HOUSE, FARRINGDON STREET, LONDON, E.C.4.

043

ELECTRICAL REVIEW

December 10, 1943

Contents :—

	Page
Editorial—Choice of Plant	765
The Rising Busbar. By J. Ashmore, M.I.E.E.	767
Conductor Sagging	769
Auto-Reclose Switchgear. By R. B. Anderson, A.M.I.E.E.	770
Power Engineers' Salaries	773
New Zealand Power	775
Research in Eire	776
Economic Ratings	777
Correspondence	778
Personal and Social	781
Commerce and Industry	783
Contents continued :—	Page
Industrial Fire Risks	786
Reactive Currents. By G. W. Stubbings, B.Sc., A.M.I.E.E.	787
Electricity Supply	789
Chimney Losses. By "Mechanolectric"	791
Financial Section	793
New Patents	798
Contract Information	799
Forthcoming Events	800
Classified Advertisements	65
Index to Advertisers	76

Managing Editor: Hugh S. Pocock, M.I.E.E.

Technical Editor: C. O. Brettelle, M.I.E.E. Commercial Editor: J. H. Cosens

EDITORIAL, ADVERTISING & PUBLISHING OFFICES: Dorset House, Stamford St., London, S.E.1

Telegraphic Address: "Ageekay, Sedist, London." Code: ABC. Telephone No.: Waterloo 3333 (35 lines). Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage. Entered as Second Class Matter at the New York, U.S.A., Post Office.

Subscription Rates, Postage free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £1 14s. 8d. per annum.

Cheques and Postal Orders (on Chief Office, London) to be made payable to ELECTRICAL REVIEW LTD., and crossed "Lloyds Bank."

THIS ACOUSTI-BOOTH IS A ZONE OF SILENCE FOR YOUR TELEPHONE

Put a Burgess Acousti-Booth in your noisiest shop and you'll be *amazed* at the "zone of silence" it provides. Noise will not interfere with your telephone service if your shop phones are in Acousti-Booths.

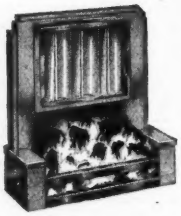
These booths have no doors, yet they are quiet inside because factory noise is soaked up by patented sound-absorbing walls. Hundreds of these doorless booths are in daily use in all kinds of factories. Easy to keep clean—no maintenance.

BURGESS ACOUSTI-BOOTH

Write to-day for Bulletin BP 131/E.R.

BURGESS PRODUCTS COMPANY LTD.
Acoustical Division, HINCKLEY, LEICS. *Phone: Hinckley 700 (3 lines)*
London Office: 72 Horseferry Road, S.W.1 Phone: Abbey 1868
Scottish Representatives: R. McCartney & Co., 142 Queen Street, Glasgow, C.1

THE FINAL PHASE OF THE WAR IS APPROACHING



Splendid news certainly—but all efforts must still be directed towards the manufacture of essentials for prosecuting the fight to its ultimate and conclusive end.

THEN our endeavour will be to meet the wishes of our old friends whose orders for MAGICOAL FIRES have had, under war conditions, to be left unexecuted.

Berry's ELECTRIC LTD.

TOUCHBUTTON HOUSE
Newman Street, London, W.1
Telephone : MUSEUM 6800 (9 lines)
Also Birmingham, Manchester and Newcastle

CAMBRIDGE DIRECT READING FAULT LOCALISER

This improved instrument gives the position of a fault as a PERCENTAGE of the LENGTH OF CABLE UNDER TEST to an accuracy of 0·1%. It employs the principle of the Murray Loop Test, the slide wire being replaced by two graduated dials. Large numbers are regularly used in important British undertakings.

WRITE FOR LIST 160 B-X

6605

CAMBRIDGE INSTRUMENT CO. LTD.
13, GROSVENOR PLACE, LONDON, S.W.1

ELECTRICAL REVIEW

THE OLDEST ELECTRICAL PAPER — ESTABLISHED 1872

Vol. CXXXIII. No. 3446. DECEMBER 10, 1943 6d. WEEKLY

Choice of Plant

Economic Factors Involved

BROADLY speaking, the issue raised in Mr. D. J. Bolton's I.E.E. paper on the Economic Rating of Motors and Transformers (reported by us last week) was the extent to which the technical aspects of design have outstripped its fundamentally economic purpose and the possibility of bringing means and ends more nearly into step. Some discrepancy between the two is only to be expected, since the economic factors, instead of being firmly based on a foundation of well-established scientific values, have to take into account comparisons of a number of dissimilar and often mutually inconvertible variables. Moreover, what may be economically sound may not be practicable from an engineering standpoint.

First Cost and Losses

It may well be that manufacturers, faced with the demand for plant that gives good performance at competitive prices, hesitate to add to the complexities of their business by taking into account, except in a general way, such diverse additional items as those referred to in the paper. Yet would it be so difficult to do so, as on first thoughts it might appear? The method of choice worked out in the paper is only a logical sequence of two near-axioms. One is that the cost of losses over the life of the apparatus may be many times its first cost; the other is that losses can almost always be reduced by a greater capital expenditure.

Although some of those taking part in the discussion of the paper disputed the author's suggestion that both designers and purchasers failed to grasp the full implications of these two principles, it seems doubtful whether they are, in general practice, implemented to anything like the degree he advocates. It is, of course, true that British manufacturers have not unduly stressed the importance of low first cost at the expense of long-term performance and that they have reaped the rewards of their far-sighted policy. The point is rather whether, in the absence of a technique of appreciation of all the economic factors involved, they can use their materials and labour to the best advantage. The desirable way of approach is neatly defined by Mr. Bolton as one that regards machine losses not merely as a temporary inconvenience to the designer who has to dissipate them, but as a permanent liability to the user who has to pay for them.

Education of Users

Possibly the greatest difficulty in applying the author's proposals would be in allocating responsibility for settling the most economic designs within the limits of the technically feasible and of the commercial need for a reasonable amount of standardisation. In these matters manufacturers alone have the necessary experience, but might find difficulty in convincing users that higher prices would be to their advantage. On the other hand users have not the necessary knowledge of what can be produced to meet their circumstances at prices they can afford to

pay. In this connection education of users (in which manufacturers might play a notable part) is very necessary, and there should be scope for consulting engineers of wide experience and high professional standing. Considerable aid in these attempts would be provided by a study of the methods advocated by Mr. Bolton. They may be open to criticism in detail, but they provide a framework for a technique of economic choice that should, as he puts it, have in mind that a low-priced motor or transformer is only one means to the end of cheap power.

Transient Faults

A VALUABLE contribution towards securing the high standard of uninterrupted service required for rural supplies is made by installing circuit-breakers designed for automatic reclosure. The large majority of faults on overhead lines, as Mr. R. B. Anderson shows in this issue, are cleared before the breaker is closed two or more times. The saving in the time of men who must otherwise be sent to the more remote spots to renew the supply after a fault, as well as the avoidance of inconvenience to consumers, is a factor that should justify an increase in expenditure on switchgear.

New Zealand Imports

AT the recent annual conference of New Zealand supply authority engineers reference was made to the poor quality of much of the electrical appliances and equipment being manufactured in New Zealand and the risks involved in their use were stressed. The position was said to be that import control left little or no choice in purchasing and the removal of the restrictions was urged. At about the same time a report from the United Kingdom Manufacturers and New Zealand Representatives' Association also referred to the shortage of appliances and went on to say that after the war there would be many years of prosperity for the electrical industry so far as the Dominion was concerned. The extent of the immediate recovery would be largely governed by the abolition of existing restrictions upon electrical imports.

Reciprocity

THESE two voices suggest that there will still be prospects for United Kingdom electrical manufacturers in New Zealand and they raise once again an outstanding consideration in inter-Imperial relations. New Zealand will expect, and may hope, that we shall continue to import from her a substantial part of our food after the war. In return we hope, and think that we should expect, that the Dominion Government will make it easier for our manufacturers to supply their products to our friends in New Zealand.

Schedule Revision

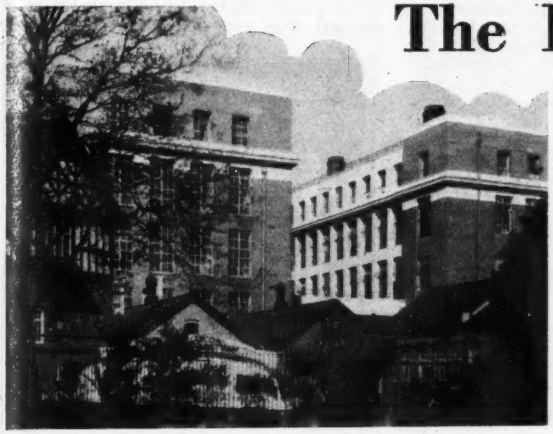
THE Electrical Power Engineers' Association has succeeded in obtaining an improvement in the salaries of their lower-paid members and at the same time the basis of the cost-of-living variations has been altered. The datum figure is now the Ministry of Labour index for June, 1939 (instead of July, 1914) and the principal variation is on the first £200 instead of £300 and is raised from £1 6s. 8d. to £5 per annum for each five points increase in the cost of living. Upon the rest of the salary the addition is reduced from 6s. 8d. to 2s. per cent. per annum. The change means an immediate all-round increase but a slowing down of further rises. The E.P.E.A. claims that its members have gained by this alteration rather greater increases than other large bodies of professional workers, but agrees that the improvement is not so much as some members were expecting.

Canadian Relaxation

AN easing of the materials position is indicated by the announcement that the Dominion Government is removing the restrictions upon the use of scrap aluminium and certain types of structural steel. It is thought that this relaxation will enable manufacturers to use more of their resources for meeting civilian needs. Further concessions affecting other materials are expected.

Flex and Flexibility

WHAT happens to worn telephone cords? The question is answered by "Pilgrim Two" in the current *Electrical Contractor*. He was recently called upon by a traveller and noticed in the traveller's bag some flex with what looked like a soldering iron handle. Upon inquiry it was found that this was discarded G.P.O. telephone flex made up as skipping ropes in which the traveller did a great deal of business in schools and training camps. "Pilgrim Two" recommends them to older E.C.A. members.



Modern multi-storey steel-framed buildings erected behind older single- and two-storey factories (Photo by courtesy of Cadbury Bros.)

The Rising Busbar

By J. Ashmore, M.I.E.E.

In the experimental installation which the author describes, an overhead busbar chamber has been adapted to serve as a rising main

THE plea by Mr. E. E. Jolly for the collation of available data as an aid to the electrification of buildings of the future (*Electrical Review*, September 10th) has prompted me to describe an experimental rising main for which I have recently been responsible. Post-war building will inevitably include blocks of flats. Recently the possibility of blocks of workshop flats has even been suggested for part of the City of Birmingham, where many of the office buildings will require replanning for electricity supply and installations.

An idea or design must be tried out before its practicability can be decided and the initial trial here described was sanctioned by Mr. Andrew Dennison, managing director of the Birmingham Tool & Gauge Co., Ltd. In this factory are already several conduits and cable rising mains, but, due to changes in the manufacturing programmes, the loads have increased beyond anticipation, entailing the provision of additional rising mains. Further, this concern is particular in requiring neatness of engineering work in addition to utility. Here it may be said that all services should be as inconspicuous as possible, particularly in domestic premises.

An overhead busbar system of the English Electric design which incorporates a number of fused plug-in points for supply to individual motors is in use in several of the machine shops, where it is anchored to the roof members in the normal horizontal position. It occurred to me to use standard 12-ft. lengths of this busbar system for a rising main required for a building where the ground floor is devoted to offices and the other floors to machine shops.

Although the busbar chamber has not been primarily developed for use as a rising main, nevertheless, due to war conditions, it was considered preferable to adapt this system, which is available from stock, rather than to call for a special design. The type selected included a metal-clad busbar chamber with

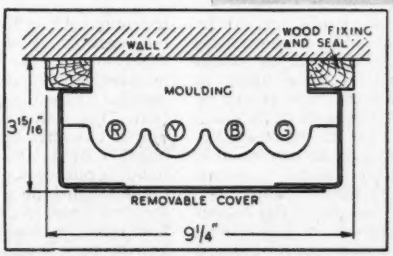


Fig. 1.—Section of busbar chamber for rising main

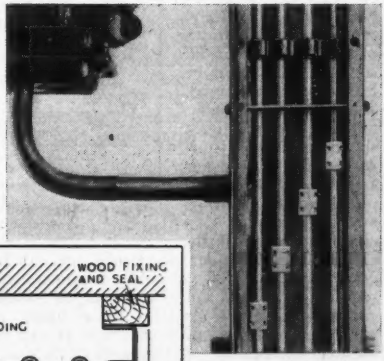


Fig. 2.—Special cable-socket clamps for tapping off

$\frac{3}{16}$ in. diameter four-wire insulated busbars. The standard chamber (fig. 1) was packed off the wall by strips of wood which also serve as a seal against dirt and vermin. Conduit wiring is used at each floor for tapping off, and special cable socket clamps were made for this purpose (fig. 2). The feed to the bottom of the busbar chamber is taken by means of conduit wiring simply because the point of supply is only a few yards away, although a four-core cable could be just as conveniently used. The installation under review has proved the method to be sound in principle, but an improvement could be effected for post-war applications by designing the busbar equipment specially for rising main applications instead of using standard horizontal busbar equipment.

Fig. 3 indicates the neatness of the general arrangement, which obviates the multiplicity of joints necessary with a cable.

There is reason to be confident that the rising busbar has many uses and advantages provided it is well designed. Round bars and tubes do not seem to offer much advantage over flat bars, chiefly because tap-off connections are not so conveniently made as with flat bars and require greater width of space. However, all such points should be carefully examined. As an example of what might be done, fig. 4 shows a 400-V four-wire rising flat-busbar scheme with two phases in use, a floor-service distribution chamber being flush-mounted to one side; the other side can be used equally well should circumstances require it. The same method of direct connection can be used for heavy loads, in which case a distribution switchboard can be used on each floor. If the tariff of flats and offices is at a flat rate for all purposes, the watt-hour meters, etc., can be conveniently housed in the distribution chamber as shown in fig. 4, thus facilitating meter reading.

It may be found that the use of flat copper bars would be advantageous in maintaining a chamber of constant dimensions for systems of various ratings. Thus it might be possible to use a single bar 0·125 by 1 in. (0·125 sq. in. section) and two or three such bars in

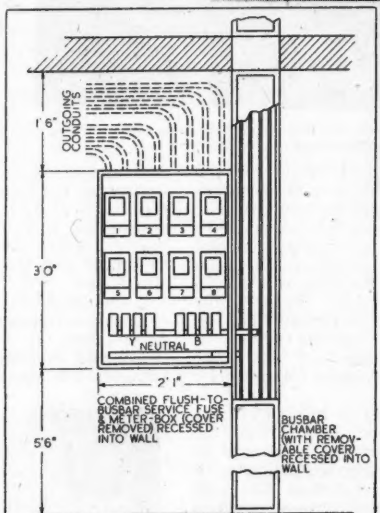


Fig. 4.—Suggested scheme for rising busbars with floor service box

Fig. 3.—Typical general arrangement of vertical rising busbars, with horizontal run of overhead busbar to left of photograph

parallel, to give an increase in capacity of 70 and 120 per cent. respectively. A greater increase in capacity could be gained by paralleling cables of given section, but considerable installation cost would render the application of busbars of adequate capacity far more economical in first cost.

For normal purposes, such as flats and medium-sized factories, bars in parallel touching each other would be quite suitable, but when heavy loads have to be carried by rising mains, the paralleled or laminated busbars would have to be spaced as recommended by the Copper Development Association. The wall recess and the section of the busbar chamber can normally be that of one brick, 9 by $4\frac{1}{2}$ in., as this is convenient for building purposes. The maximum load to be carried in this space is approximately 620 A to the first floor, decreasing as each successive floor is reached together with section of copper, but the same load could be carried up to the top floor without tap-off points.

Only two or three bars need be installed in the chamber. I consider it might be wise to keep the section of the chamber standard to suit building requirements, as any saving in reduction of section would probably be outweighed by cost of building a smaller recess than 9 by 4½ in. Heavy loads needing special chambers would of necessity have to be dealt with individually. As no busbar chamber has been developed for the purpose, the comparative cost cannot be truly assessed, but for the installation described it can be shown that the use of a busbar chamber having a through-current rating of 250 A compares favourably with that of an installation applying a 0·15 sq. in. by 3½ core p.i.l,c. and s.w.a. cable.

Referring now to unit-type switchboards, the usual construction consists of a horizontal busbar chamber with fuse-switch units mounted above and below, but in fig. 5 is shown as alternative design using a vertical busbar chamber, several of which have been in use for many years. This design in certain circumstances offers advantages over the centrally disposed horizontal busbar with switches mounted above and below. However, both these methods have their right place in practice.

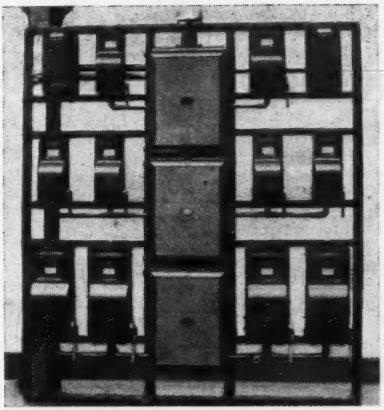


Fig. 5.—Unit-type fuse board incorporating vertical busbar chamber

Conductor Sagging

Proposed Revision of Regulations

IN a paper on "The Problems of Conductor Sagging on Overhead Transmission Lines" which was presented on Wednesday last before the I.E.E. Transmission Section, Messrs. C. O. Boyse and N. G. Simpson (Callender's Cable & Construction Co., Ltd.), review the present position in regard to the calculation of overhead-conductor sags. It would, it is suggested, greatly facilitate exchange of ideas on the subject if the concise parabolic formulæ and notation recommended by the authors were adopted as a standard. Extreme accuracy, it is stated, is usually of little practical value in view of the necessarily arbitrary assumptions and variable factors that are introduced, but a description is given of the procedure to be adopted in order to secure greater accuracy where necessary.

"Factor of Safety" Deprecated

The authors recommend that the expression "factor of safety" should not be used in connection with overhead lines and that certain clauses of the Electricity Commissioners' Overhead Line Regulations should be revised on the following basis: The tension in a line conductor should not exceed three-quarters of its breaking strength when subjected to an ice load of radial thickness (1·6d + 0·5) in. at 22 deg. F, and a wind pressure of 8 lb. per sq. ft. Supports should withstand the loads thereby imposed multiplied by a loading factor of 2 for wood poles or 4/3 for other types of support. Supports carrying low-voltage service lines should withstand an additional load of 250 lb. in the direction of the service, multiplied by the appropriate loading factor. The wind pressure on the supports themselves (other than for low-voltage line supports not more than 50 ft. in height) should be allowed for on a suitable basis.

These proposals would apply to all classes of line as minimum requirements for Great Britain or for countries experiencing similar weather conditions. For regions where ice loading does not occur, it might be possible to determine with reasonable accuracy the maximum wind loads that will ever be experienced. The sagging of conductors on low-voltage lines should be based on a maximum still-air sag of 3 ft. 6 in. on a 180 ft. span, in accordance with curves given in the paper.

The authors consider that the proposed revision of the Regulations should be accepted for all lines, including crossings of roads, railways, rivers and canals.

The paper does not deal with suspended cables, or combined Post Office and low-voltage distribution lines.

Auto-Reclose Switchgear

Promoting Reliability of Rural Supplies

By R. B. Anderson, A.M.I.E.E.

IT is generally agreed that if rural networks are to be sufficiently widespread to afford adequate supply, overhead construction must be used and special consideration given to ensuring maximum continuity of service. In the event of unavoidable interruptions, rapid re-establishment of supply must be effected.

Maximum continuity of supply depends largely on skilful design and efficient maintenance. Rapid re-establishment of supply is influenced by the lay-out of the network, combined with a carefully planned distribution of the operating staff, and by the use of automatically operated switchgear at selected points on the system. The use of automatically operated switchgear will assume even greater importance as rural networks are extended to the more remote localities.

Overhead line failures can generally be attributed to causes which occur roughly in the following proportions:—Lightning, 25 per cent.; snow and sleet, 20 per cent.; high winds, 15 per cent.; birds, 5 per cent.; miscellaneous and unaccounted for, 35 per cent. The most serious troubles are to be expected as a result of snow and sleet. These breakdowns are not all of a permanent nature and in the majority of cases the lines can be switched in again. The advantages of attempting quick reclosure of the circuit are therefore apparent.

Automatic reclose switchgear has been in regular use in this country for the past ten years or more. One of the first installations of its kind was put into operation some twelve years ago and consisted of the automatic change-over and reclose features later described.

The method of reclosure varies. Motor-operated, spring-operated and hydraulic mechanisms with oil as the operating fluid are in use and pneumatic operation can be conveniently adopted for multiple installations. AC solenoid operation has been used to a limited extent, but probably the most popular form is the DC solenoid, which, like the pneumatic piston, has an ideal effort stroke and provides maximum force at contact closure.

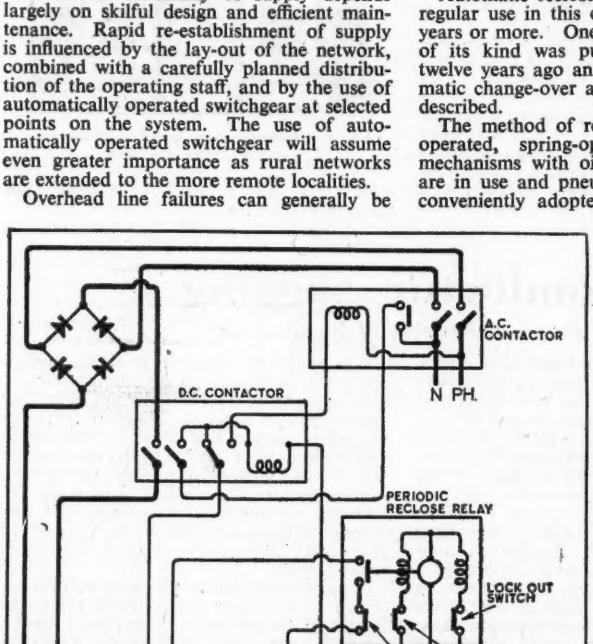


Fig. 1.—Connections for control circuit of DC solenoid-operated auto-reclose circuit-breaker

The periodic-reclose relay, which controls the operation of ground-type automatic gear, takes the form of a self-contained unit, its main functions being to control the time interval between reclosures, to ensure that the automatic gear is locked out after a predetermined number of attempts at closure, and to ensure that the mechanism is re-set and the full number of reclosures are again made available if the fault disappears and the circuit-breaker remains closed.

Periodic relays take various forms and may be clockwork or otherwise mechanically actuated or they may sometimes depend on a drive derived from a small electric

motor forming an integral part of the relay.

In one successful design a small split-field motor drives a timing disc. The disc is provided with a number of holes regularly spaced round the circumference suitable for the reception of setting plugs which, when inserted, extend beyond the back of the disc. On the oil circuit-breaker tripping, the forward field circuit of the relay motor is closed by the circuit-breaker auxiliary switch and the timing disc is driven in a clockwise direction, and, after a length of time, depending upon the hole in which it is located, the plug engages with a lever which makes the circuit to initiate reclosure of the breaker. Should the breaker immediately trip, the disc continues to be driven in a clockwise direction and, after the pre-determined time has elapsed, the second plug engages and another attempt at closure is made. If the fault persists, these operations will continue until the lock-out plug engages with a separate lever to open the relay motor circuit and bring the mechanism to rest. The circuit-breaker then remains open until operated by hand.

If the fault has been of a transient nature and the circuit-breaker remains closed, auxiliary switch contacts on the latter open the relay-motor forward field and close the reverse field, thus allowing the motor to run in the reverse direction, driving the timing disc back to its initial position to make the full number of reclosures again available.

A typical DC solenoid auto-reclose circuit diagram is shown in fig. 1. The DC supply is obtained from a rectifier connected to a reliable AC circuit. When the breaker trips, the auxiliary switch contacts complete the circuit to the forward field of the reclose relay motor and the reclose-relay contacts close as previously explained.

These contacts complete the circuit to the DC contactor coil. This contactor, when operated, closes the solenoid circuit and also pulls in the AC contactor to energise the solenoid through the rectifier. When the circuit-breaker closes, contacts on the auxiliary switch shut down the AC contactor, which in turn breaks the AC supply to the metal rectifier and the circuit for the DC contactor coil and the circuit returns to normal. The o.c.b. auxiliary switch contacts in addition break the forward running circuit of the periodic relay and start the re-setting action. All load switching is carried out on the AC contactor and solenoid-induced voltages are dissipated through the metal rectifier.

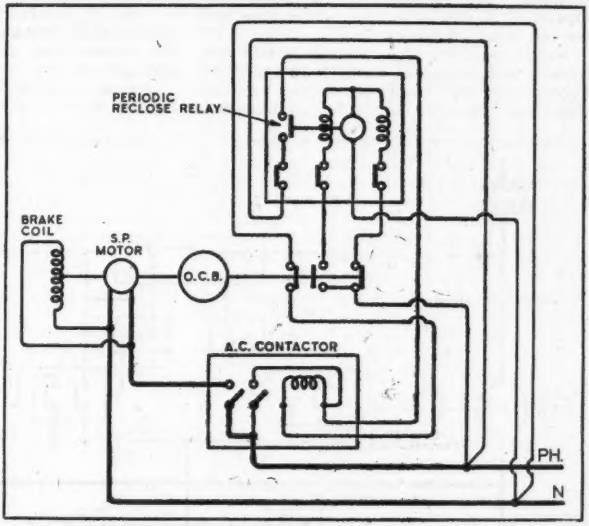


Fig. 2.—Connections for control circuit of motor-operated auto-reclose circuit-breaker

Motor-actuated mechanisms utilise small single-phase motors with suitable speed-torque characteristics and need only be intermittently rated. Fig. 2 shows such a circuit embodying a single-phase repulsion-induction motor. An even simpler circuit results from the use of a mechanical type of periodic relay.

The modern tendency is to arrange for four reclosures before lock-out with fifteen-second time delays between reclosures. On some circuits a 10-10-15-30-sec. cycle can be used. Ten seconds is considered adequate time for dielectric recovery at the point of flash-over. The time delay chosen will be principally determined by the type and size of the rotary plant supplied from the line and the time taken for its no-volt protection to operate.

The British Standards Institution recommends that all circuit-breakers in excess of 150-MVA breaking capacity shall be provided with power operation. Consequently, the provision of auto-reclose features may increase the first cost by about 12 per cent. for 11-kV gear and by about 6 per cent. for

33-kV gear. For gear below 150 MVA, which would in normal circumstances be manually operated, the increase in first cost might amount to about 45 per cent. Less expensive forms such as one-shot spring reclosure are worthy of consideration. Operation by falling weight can be obtained for the lower capacities only.

Subsidiary lines feeding rural groups are usually constructed of fairly long spans of light-section high-tensile conductor, and, as they may become vulnerable to transient faults at certain seasons, the application of relatively inexpensive pole-mounted mechanically operated circuit-breakers can very often be justified.

Pole-mounted switchgear up to about 75-MVA breaking capacity may be operated by falling weight, coiled spring or other source of stored energy. The delay mechanism takes the form of a dash-pot or escapement assembly providing about three-quarters of a minute delay. Circuit protection is afforded by series trip coils which must be of a range suitable for grading with the earth-leakage relays in the main substations.

Fig. 3 shows in diagrammatic form a fully automatic substation switching arrangement. Feeders F_1 and F_2 are supplied from the 11-kV busbars and are equipped with motor-operated reclose mechanisms controlled by mechanically actuated periodic relays.

The supply to the 11-kV busbars is derived from step-down transformers T_1 and T_2. Should the 33-kV supply to T_1 fail, the stand-by transformer T_2 is automatically switched in. When supply to T_1 is restored for a pre-determined time, service is automatically resumed by this transformer. T_1 and T_2 o.c.b.s are tripped by delayed action under voltage relays, and F_1 and F_2 by inverse-time over-current and earth-leakage relays.

The selection of the two 33-kV circuits is carried out by the selector relay (S), which has a preferential bias in favour of T_1. This circuit is kept in commission when in condition to maintain supply. Interlocking is provided by cross-connecting auxiliary switch contacts on T_1 and T_2 o.c.b's.

The performance of auto-change-over gear depends largely on the measure of independence of the incoming supplies, but estimates based on operating experience place the effectiveness at over 96 per cent.

Similar estimates for auto-reclose equipments installed in an area subject to rigorous weather conditions place the successful operations at over 60 per cent., that is to say, just over 30 per cent. of the faults which develop are of a permanent nature and cause the breaker to lock out. Of the successful reclosures, over 50 per cent. are achieved on the first attempt and about 20 per cent. on the second attempt. The provision of four reclosures would therefore seem to be adequate.

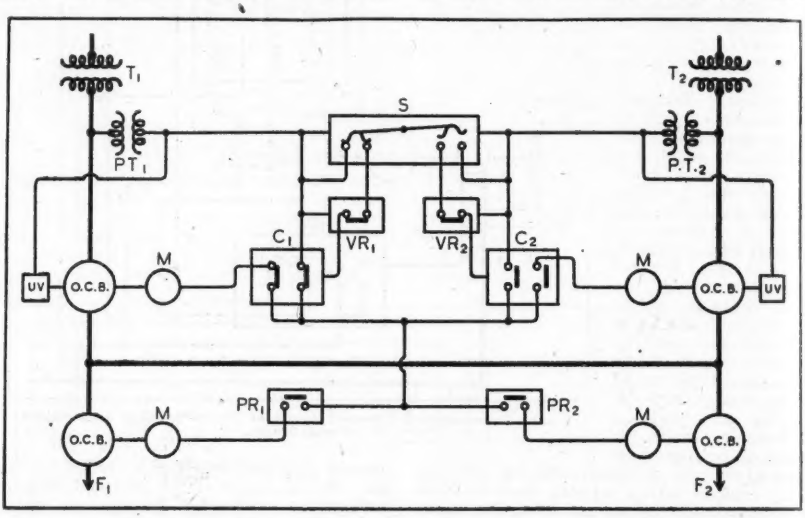


Fig. 3.—Fully automatic substation switching comprising auto-change-over and auto-reclose-operation
PT, potential transformers supplying control circuit, closing motors, heating and lighting, etc.; S, potential selector relay biased in favour of T_1; VR, voltage relays to ensure suitable operating voltage available; C, contactor; M, repulsion-induction motor operating circuit-breaker; PR, periodic reclose relays; UV, delayed action under-voltage relay for circuit-breaker tripping

Switchgear of this description must be entirely dependable. The gear may remain quiescent for long periods, but it is of paramount importance that when required it shall faithfully fulfil the duties for which it was designed. Undoubtedly, if the apparatus is left static for a period of months, there is a possibility of failure due to a corroded contact, sticky escapement, faulty auxiliary switch or other minor matter, which, after an operator arrives at the substation, can be put right in a few minutes.

Trouble of this kind can be avoided if the gear is operated at least once per month. If no service operation takes place, operation should be manually initiated, preferably by hand-operation of the protective relay. Apart from overhaul of the control gear at the same time as circuit-breaker overhaul no other special attention is necessary.

Improvements in design should reduce the amount of maintenance necessary for high-voltage switchgear both in the oil circuit-breaker itself and on its auxiliary components. Auxiliary switches are a frequent source of trouble, often aggravated by inaccessibility, and vacuum or oil-sealed types present advantages, particularly when used in damp situations.

The B-3′-MB-3′-MB cycle for non-reclose or "the number of operations and intervals for which it is rated" for auto-reclose circuit-breakers, as referred to in Clause 60 (ii) and (iii) of B.S. 116, may, during times of stress, have to be considerably exceeded on a wide-spread distribution system. Indeed, it is not difficult to imagine this duty being repeated several times in a relatively few hours during bad weather, and it will obviously not be possible to legislate always for immediate overhaul. It is suggested that this Clause, together with Clauses 90 and 98, be extended to cover more onerous operating conditions.

High-speed automatic reclosure at the present time is outside the realm of the rural area, but it is not unreasonable to hope that high-speed protection and high-speed reclosure may in the future become available at economic cost for the main feeders at least. By this means reclosure within twenty cycles is possible, which, if successful, would not constitute an interruption to supply.

Power Engineers' Salaries

New Cost-of-Living Adjustment Method

As from November 1st, 1943, a revised method of calculating cost-of-living variations in the salaries of electrical power engineers is to operate. The existing Schedule A attached to the 1923 agreement (based upon 1914 cost of living figures) is superseded by a new schedule based upon the cost of living in June, 1939, and all variations will be calculated on this new schedule.

In addition the existing Clause 39 of the agreement has been replaced by a new clause in the following terms:—

"The basic salaries set out in the schedule hereto are related to the cost of living as published in the *Ministry of Labour Gazette* for the month of September, 1939. On the first day of January and the first day of July in each year (hereinafter called the 'dates of adjustment') the basic salaries shall be adjusted by adding thereto: 5 per cent. on the first £200, and 2s. per cent. per annum on the remainder of the salary for each completed increase of five per cent. in the cost of living calculated on the cost of living in September, 1939. The percentage increase in the cost of living at each date of adjustment shall be calculated by taking the average of the six then latest monthly figures of percentage increases over the cost of living figures in September, 1939, as published in the *Ministry of Labour Gazette*.

"Provided that on every such date of adjustment the adjusted salary shall be calculated to the nearest £ per annum and any fraction of a £ amounting to 10s. or over shall be reckoned as a complete £. Provided also that if at any time the adjustment of salaries under this clause would reduce the salaries below the basic salaries set out in the Schedule hereto, such adjustment shall not be put into operation, but the National Joint Board shall thereupon reconsider the salaries in the light of the circumstances then existing."

The *Electrical Power Engineer* points out that the new arrangement will result in the greatest benefit to the lower-paid men. For instance those who in June, 1939, were in receipt of a salary of £208 will receive, as from November 1st, £258, an increase of £50 on their 1939 salary or of £23 on their present salary. Those who were receiving £408 in June, 1939, will receive £459, an increase of £51 over the 1939 salary or £15 above their present figure.

It is stated that the general effect of the new clause will be to ensure to the technical staff at least the same amount of increases as have been granted to the manual workers. The increases are said to be slightly more than those claimed by the E.P.E.A. and also rather more than those granted to local government officers, civil servants and teachers.

Extension of Classes

Settlement has also been reached in the matter of station classification. The existing classification ended at Class M, over 250,000 kW. This class is now to cover stations

from 250,001 to 350,000 kW with salaries 7½ per cent. above Class L. Two new classes are added: Class N, 350,001 to 450,000 kW, salaries 7½ per cent. above Class M; and Class O, 450,001 and over, salaries 5 per cent. above

agreed upon by the National Joint Board. The title "Schedule" hitherto given to the document is considered to be a misnomer. Consequently it will be referred to in future as the "Agreement Relating to Salaries" and

Capacity or Maximum Demand in Kilowatts

Grade	Class A 1,000–2,000			Class B 2,001–4,000			Class C 4,001–6,000			Class D 6,001–8,000			Class E 8,001–13,000			Class F 13,001–25,000			Class G 25,001–50,000		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
1	527	538	550	562	578	595	611	621	631	642	656	670	—	—	—	—	—	—	—	—	—
2	463	472	483	492	507	521	535	545	554	564	578	592	606	620	635	—	—	—	—	—	—
3	421	429	439	447	461	475	488	496	505	512	526	538	553	559	566	573	585	598	611	625	640
4	367	378	390	401	409	418	425	437	449	461	472	483	494	501	507	513	530	546	563	575	586
5	348	357	365	374	384	395	405	412	420	426	437	446	457	467	479	489	495	502	508	523	537
6	319	330	339	351	357	365	372	381	392	401	407	414	420	429	440	449	459	467	477	487	496
7	292	301	309	319	330	339	351	356	361	367	376	385	394	402	412	421	425	430	435	448	462
8	292	296	301	306	310	314	319	328	336	345	351	356	361	370	378	387	395	402	410	415	419
8a	275	278	281	286	289	292	296	304	311	319	325	331	336	344	354	361	369	376	383	388	394
8b	258	261	264	267	270	273	277	283	289	295	300	307	312	320	328	335	342	349	356	362	369
9	—	—	—	—	—	—	258	263	268	273	279	285	291	296	304	310	317	323	330	336	343
9a	—	—	—	—	—	—	—	—	—	258	263	269	274	277	280	283	288	292	297	304	309
10	—	—	—	—	—	—	—	—	—	—	—	—	258	260	262	264	266	267	270	275	280
10a	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	258	263	268

Grade	Class H 50,001–100,000			Class J 100,001–150,000			Class K 150,001–200,000			Class L 200,001–250,000			Class M 250,001–350,000			Class N 350,001–450,000			Class O Over 450,000		
	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
3	654	674	694	713	731	748	767	786	804	823	843	864	884	906	927	949	965	981	997	1013	1029
4	598	612	627	642	657	673	688	706	722	739	758	776	795	814	834	853	867	881	895	909	925
5	554	563	574	583	598	612	626	642	657	672	688	705	722	740	758	776	789	802	815	828	842
6	506	520	534	549	563	576	590	604	619	633	648	664	680	696	713	730	741	754	766	778	791
7	475	483	491	499	511	523	535	549	562	576	590	603	618	633	648	663	673	685	695	707	718
8	423	435	447	459	470	481	492	505	516	529	541	555	568	582	596	610	620	630	640	650	661
8a	399	409	419	429	440	450	461	472	483	494	507	518	531	544	557	571	580	589	598	608	619
8b	375	383	392	400	410	420	429	440	450	461	472	483	494	507	518	531	539	548	557	566	576
9	351	357	365	372	380	390	399	408	418	427	438	448	459	470	481	492	500	509	516	525	532
9a	316	324	331	338	347	355	364	373	381	391	400	410	420	430	440	450	458	465	472	480	487
10	285	291	299	307	314	321	329	336	345	354	362	371	379	389	398	407	414	421	427	434	442
10a	273	279	284	290	296	303	309	317	325	331	339	348	356	365	374	382	388	395	400	407	413
10b	258	263	268	273	279	285	290	296	303	309	317	325	331	339	348	356	362	368	374	379	386
10c	—	—	—	258	263	269	274	280	286	291	296	304	310	318	326	332	338	343	349	355	361
11	—	—	—	—	—	—	258	263	269	274	280	286	291	296	304	310	315	321	326	331	336
11a	—	—	—	—	—	—	—	—	—	258	263	269	274	280	286	291	295	299	304	309	313
11b	—	—	—	—	—	—	—	—	—	—	—	—	258	263	269	274	278	281	286	290	293

Class N. Provision is also to be made in the latter class for incremental advances after two years and four years. There are at present only six undertakings which qualify for these new classes.

Members of inside staffs whose stations are transferred from Class L to Class N, will all be entitled to the increased classification. Increased classification in Class N and upward will be subject to the same conditions as apply to the outside staffs under Clause 36, *viz.*, that the increased classification will apply only to those whose duties and responsibilities have been increased thereby. This amendment is to operate from January 1st, 1944.

Reprint of Agreement

In view of the importance of these amendments it has been necessary to reprint the agreement, at the same time making textual amendments which have previously been

the term "Schedule" will be confined to the actual table of salaries which is attached to it. The revised schedule is reproduced herewith.

To some of the grades specific titles are attached, as follows:—1. Deputy chief official; 3. Power station superintendent or mains superintendent (with charge of substations); 4. Mains superintendent (without charge of substations); 7. Shift charge engineer (Class J and over); 8. Shift charge engineer (Classes A to H inclusive); 8b. Substation charge engineer; and 9a. Switchboard attendant.

In the table column (*a*) gives the salary for the first two years; (*b*) the salary for the third and fourth years; and (*c*) the salary after the fourth year. Employees in the London area are entitled to an additional 5 per cent. on the stated salaries and in any district where conditions justify lower remuneration a reduction of 5 per cent. in the rates can be made by agreement.

New Zealand Power

Ten-Year Plan to Relieve Shortage

ALMOST the sole topic of resolutions passed at this year's conference of the Electric Power Boards' and Supply Authorities' Association of New Zealand held at Napier was the serious power shortage which has developed. Previously the Electric Supply Authority Engineers' Association had passed a resolution expressing concern at what it described as " the desperate position of Government electricity supply "and strongly urging that supply authorities should in future have a definite voice in proposals for ensuring sufficient generating capacity.

The Government's case was put by the Minister of Finance, Mr. W. Nash, in officially opening the main conference in the presence of 250 delegates. The shortage, he said, was not peculiar to New Zealand, similar difficulties were being experienced in the United States and England. He announced that the Government had now approved a ten-year plan which provided for an additional 730,000 kW of plant, and if this could be accelerated so much the better. Past development had averaged only 7,000 kW a year.

Other Countries' Experience

The best plan for obtaining the necessary equipment, Mr. Nash said, was for one or two representatives of the supply authorities and a member of the Hydro-Electric Branch to travel to the United States, Canada and England to investigate how these countries were coping with their power difficulties and what equipment they could spare for New Zealand; if they could possibly help he knew they would do so. (He has since announced that a mission is leaving at the earliest possible moment for this purpose.)

Turning to the control of electricity in the Dominion, he declared that the Government could never shed its responsibility, but he believed that the setting up of a State Electricity Department not subject to Public Works Department control was worth considering.

After an address by the Electricity Controller, Mr. F. T. Kissel, who reported that the Arapuni plant had been run for a year at a load factor of over 80 per cent., 30 per cent. above the ordinarily accepted load for hydro plant, the regional reports on power supply were submitted. It was recommended that steps should be taken immediately to provide for a third major hydro-electric scheme (in addition to Upper Waikaremoana and Karapiro) and that the policy in connection with small hydro-electric projects should be revised to enable rapid economic development of available sites. To alleviate the shortage in 1944, 1945 and possibly 1946 efforts should be made to procure steam-driven plants at an early date, and the erection of a major steam plant in the Waikato coalfields should be thoroughly investigated. In the south, lake control was considered to provide the only prospect of early relief; this would vitalise, for winter load, the " frozen asset " portion of the Waitaki plant, long since installed but lacking water in winter.

Separately, a report was submitted by Mr. G. Smith (Central Waikato E.P.B.) on the proposal to erect a steam power station in the Waikato near the coal supplies. It was contended that an ample supply of water could be obtained and that the plan would stabilise the mining industry by utilising surplus coal mined in the summer months. Referring to this proposal the Minister of Finance said that there would be difficulty in obtaining adequate supplies of coal unless more men were released from the Forces. The matter was carried further in a resolution of the conference urging the Government to release miners from the Army where practicable.

The question of control of the industry was discussed at length on a resolution brought forward by the National Co-ordinating and Control Committee. The conference unanimously recommended that the status of the Hydro-Electric Branch of the Public Works Department should be raised and that it should be reconstituted as a State Electricity Department. It was also decided that the question of commissioner control should be referred to the executive for a full report. Other resolutions urged the Government to establish a Hydrographic Survey Department and to give urgent consideration to controlling the sale of electrical appliances.

Inferior Equipment

At the earlier conference of engineers a number of interesting points regarding installations and equipment were raised. One resolution recommended that representations should be made to the Chief Electrical Engineer and to the Ministry of Supply concerning the poor quality of many electrical appliances and equipment manufactured in New Zealand to-day. It was pointed out that owing to import control little or no choice existed and in many cases actual hazards were set up in a very short time due to inferior material, short life, etc. It was therefore recommended that steps should be taken to have the relevant import restrictions removed.

Technical recommendations were that some standard should be set up for the timber used to support conduit casing or c.t.s. because

some contractors were using any old box wood; that the minimum size of a flush type switchboard should be 18 in. by 18 in.; and that the height of switches on the board should be reduced to 6 ft. 6 in. It was also suggested that in larger buildings (over £2,000 value or 20 kW connected load) the electrical installation should be separate from the main specification and should not be directly controlled by the architect, but should be approved by a consulting electrical engineer or a supply authority engineer. This, it was felt, would allow of a better type of installation, improved lighting, and provision for extensions.

A report was submitted by Mr. A. Buckingham (North Canterbury E.P.B.) based on replies to a questionnaire on heat storage ranges. The advantages of such ranges were stated to include the following: less transformer and secondary line capacity utilised; return of larger margin over power costs; in some respects, particularly in kitchen heating and the flat-rate charge, they make a stronger appeal to consumers; and less maintenance is needed. Disadvantages included sensitivity to voltage fluctuations; no flexibility of operation; adverse effect on system diversity; and inefficient operation.

Minister Rebuts Criticism

Some of the points of criticism raised at the conference were dealt with by the Minister of Works (Mr. Semple) in the House of Representatives. He declared that it was "hitting below the belt" to blame the Government for the shortage. The cause of shortage was that more than 4 per cent. of the power generated in the North Island was being used by military camps and hospitals. The war had also been responsible for taking away men from various schemes, some of which would otherwise have been completed by now; there would then have been no shortage. Between 1935 and 1942 there had been established 1,097 new factories employing 37,856 hands. It was impossible to obtain machinery. Some that had been ordered had been lost on the way out and some had been awaiting shipment for two or three years.

Announcing the ten-year plan adopted by the Cabinet, Mr. Semple said that as soon as the necessary man-power was available the Karapiro scheme would be pushed forward; between 200 and 300 men were now on the job and in six months the number would be 500, to be later increased to 1,000. Defence needs had diverted plant and personnel, but with the improved position in the Pacific it was now possible for a number of men to be released from service with the armed forces. Manufacture of the plant was in hand in Great Britain and his Department was hopeful of obtaining delivery of the most important items during next year. In addition to Karapiro, the Department was starting on the upper development at Waikaremoana and had been fortunate enough to secure some partially constructed plant suitable for this particular site.

Reporting on the conference at a meeting of the Auckland E.P.B., Mr. S. J. Harbutt (chairman) said that he and others had come to the conclusion that the Public Works Department did not want interference on the part of supply authorities, and that it did not appear to have any desire to introduce either coal or oil power plants.

The foregoing abstracts are taken from the *New Zealand Electrical Journal*, official organ of the Electric Supply Authority Engineers' Association and the N.Z. Institute of Electricians.

Research in Eire

Meeting War Conditions

DAIL Eireann has just voted a sum of £10,850 which brings up this year's provision for the State Emergency Research Bureau to a total of £32,850, compared with £24,500 available in 1942. In a recent review of the Bureau's activities Mr. de Valera said that medium-scale experiments had been made in iron production by electro-deposition, and the manufacture of ferro-silicon. The processes would be held in reserve for development in case the supply position worsened. The manufacture of carbon electrodes for electric arc furnaces had been satisfactorily developed and production was being carried out by the company which collaborated.

The Bureau has produced on a medium scale lead oxide for use in batteries and has had separators of Irish timber made by a commercial firm. Both components have been tested in road batteries with encouraging results. Zinc had been successfully reclaimed on the laboratory scale from disused dry batteries. Commercial production of plates and oxide for battery manufacture were being explored following successful experiments.

The main part of the work in hand related to the fuel problem. This work would be of value with respect to the production of gas from peat. The sentiment of the Dail, as revealed by observations from a number of members, was that any reasonable amount expended on tests, of the potentialities of turf for power and fuel production was a good investment. Mr. Larkin, Junior, Labour Member asked if the results were to be handed over to private enterprise without return. Mr. de Valera replying at the close of the debate said that they were dealing with an organisation set up to solve emergency problems rapidly. They had an Industrial Research Council dealing with long-term problems and would have in the future one which would study all economic possibilities.

With regard to the processes developed through the Emergency Research Bureau, if this body was to survive as a permanent institution it would have to decide whether to publish results and let commercial firms use these in competition or devise a scheme whereby the patents would be vested in the State or in the Bureau on behalf of the State. They must avoid having any particular firm benefiting by something paid for by the community.

Economic Ratings

Capitalisation of Power Savings

IN opening the discussion on the papers presented by Mr. D. J. Bolton before the Institution of Electrical Engineers on December 2nd, entitled "The Economic Rating of Motors and Transformers" and "The Economic Flux Density in Large Supply Transformers" (see our last issue, page 748), Mr. C. W. Marshall (C.E.B.) said that in the original specifications for the grid transformers the value of fixed loss was assessed at £45 per kW, but under present conditions it would be £107. That figure amplified Mr. Bolton's plea for low flux density on purely economic grounds, but the exact economic effect depended upon the copper losses. The loading of grid transformers, however, depended on power station efficiency, availability of generating plant and other factors, which were of greater economic importance than their losses.

A flux density of 11 kilo-lines per sq. cm. had been adopted for the grid mainly to reduce harmonic and noise troubles, but during the war higher flux densities had been taken. Prior to the war large German transformers had been built having a flux density exceeding 16 kilo-lines per sq. cm. The use of a standard figure of loss for 10 kilo-lines per sq. cm. was desirable. This ranged from 0·63 to 0·49 W per lb. for British material, but 0·35 W per lb. was reported with foreign iron. British transformer manufacturers needed a much higher grade of iron in order to compete successfully abroad. He advocated the installation of integrating meters on all large transformers to measure both the power transformed and the losses.

Increased Expenses

Mr. D. B. Hoseason (Brush Electrical Co.) submitted that the extra cost of a larger motor or transformer was not merely the increase in the manufacturer's selling price; account must be taken of increased rates, increased insurance premiums, the correspondingly higher costs of overhauls, spares and replacements, which made the position nothing like so favourable to under-running. Many of the small motors were more likely to be used for only six or eight years instead of twenty years, as the machines driven became obsolete. There was also a great difference between the interest payable on a loan and the earning power of borrowed money, and when one applied the author's figures to the latter they would fall into line with best modern practice.

Sir Frank Gill urged that more investigations of this kind should be undertaken. The really big jobs were not in the narrow strictly technical field, but embraced also the business side. He believed that that would force the teaching of economics in universities and schools.

Mr. R. M. Charley (English Electric Co.) said that during the war the cost of copper had increased by about 27 per cent., but that of transformer steel by nearly 60 per cent., so that what was most economic in 1939 was not so to-day. With constant flux density lower iron losses could be obtained with improved quality of steel, which would need to be much better than it was now to enable transformer manufacturers to meet international competition.

Convincing the User

Mr. E. T. Norris (Ferranti, Ltd.) said that the majority of transformer purchasers in this country had found out for their own particular cases the most suitable capitalisation values, which had been greatly facilitated by the fixing of the grid tariff. Nevertheless many users were apparently reluctant to make use of the results of capitalisation. He feared that the average user might look with suspicion on a suggestion from the manufacturers that he should pay 50 per cent. more for his motor or transformer, even though it was justifiable. The views of users and consulting engineers on power-factor penalties would be of value, for those charges greatly affected the author's conclusions.

Taking the author's figures and leaving out the power-factor penalty, it would be worth paying £27 more per ton of steel in order to get 10 per cent. less iron loss. There were other ways of reducing loss than by altering flux density, and users should give the manufacturers capitalisation values for iron and copper and power factor and leave the manufacturers to design the most economical proportions of apparatus. In this he was supported by Mr. Leslie Smith (British Electric Transformer Co.) who also pointed out the importance of size and weight.

Dr. E. Billig (E.R.A.) said that the optimum figure of density could immediately be obtained mathematically in one step, and his own calculations agreed fairly well with the author's example. Mr. Shinnie said that for motors the iron loss per lb. could be reduced by using a different grade of steel, but the BH curve showed that this frequently increased the magnetising current.

Author's Reply

Mr. Bolton, in his reply, said that he believed that the items mentioned by Mr. Hoseason could be covered by a comparatively small

addition to the interest rate. They did not affect the method and would not greatly affect the results. Capitalising had been done very often but in a crude way. If a case based on a standard plant, the manufacturing cost of which was ascertainable, were established, it would provide a datum line; when the designer was handed the relevant data, he could produce the best transformer to meet the requirements. The paper was an attempt to assist him to do so, and criticism of the data itself was largely beside the point.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Transformer Restrictions

MR. KENNETT'S remarks have proved very helpful in elucidating some rather ambiguous statements in the Electrical Transformers Order. The Order, though timely, would to my mind have been more timely three years ago. Regarding the possibility of eliminating wasteful man-hours in designing a completely new unit where a duplicate would have been adequate, nothing has been done. As a consequence, customers are still permitted to have things pretty much their own way, restriction or no restriction.

It behoves the transformer manufacturers to guard against this and other wasteful practices now prevalent in the manufacture of transformers.

Nelson, Lancs. A. G. BRASSINGTON, A.M.I.E.E.

Prices of Second-hand Plant

EARLY this year you published some correspondence on the subject of the employment of used electric motors and generators and views were expressed advocating the compulsory declaration by the owners of surplus electrical plant. I ventured the opinion that there was little difficulty in obtaining sufficient quantities of this class of plant, but that the chief trouble was the supply of additional skilled labour to do the necessary reconditioning or converting work and I further suggested that if it was found that adequate supplies of surplus plant were not forthcoming, suitable publicity by the firms capable of handling this class of business would produce the desired results.

It would appear that my view was correct, for the Ministry of Supply, Machine Tool Control, has not, up to now, made any order for compulsory declaration by owners of surplus electrical plant and, further, the firm with whom I am associated, who handle several thousand used machines a year, are to-day carrying a larger stock than at any time for the past two years.

I think it is generally agreed that all forms of Government control in industry are at least irksome, particularly to those responsible for their operation, but there have been many cases where unwillingness or lack of ability of a particular section of industry has necessitated Government action. The working of the Control Order affecting the sale of motors and generators has undoubtedly created an increased demand for second-hand plant and up to the present there has not been any form of price control, but if some firms engaged in this business continue to charge the prices they are now demanding, it will not be surprising to find that a Price Control Order is made and in my view, if this is done, the "trade" will have only itself to blame.

Only one instance of several which have been brought to my notice recently was the sale of a perfectly standard motor without any accessories at a price nearly 100 per cent. above the present-day manufacturers' price; this machine is over twenty years old.

I sincerely hope you will give publicity to these facts and that the offending parties will reconsider their sales policy.

Finchley. W. E. LAWTON.

Distribution Maintenance

IN the report of the discussion of the I.E.E. paper on "Maintenance of Distribution Plant and Mains on A.C. Networks," which appeared in your issue of November 19th, I am quoted as having advocated "frequent visits by maintenance men to manufacturers' works." The point actually arose in connection with the authors' statement that they considered "that works experience in a manufacturing company should be gained by an engineer *before* he joins a supply undertaking." My contention was that in view of the varied equipment with which a supply engineer was required to be familiar, *e.g.* steam raising plant, switchgear, overhead lines, transformers, cables, etc., and the specialised legal, administrative and commercial knowledge which he was required to possess, training for entrants into the supply industry could best be given by supply undertakings themselves, although this training might well be supplemented by "frequent visits to manufacturers' works."

With reference to transformers, the authors stated that insulation resistance tests on the windings "generally include cables, cable boxes and circuit spouts of switchgear." As it is usually fairly easy to disconnect the windings from this supply equipment, and as it

is indeed necessary to disconnect it if the transformer core is to be lifted, I suggested that windings should be tested separately.

I further suggested that more detailed reports on the work carried out and on the condition of plant were desirable, and showed specimen cards which could be used by the engineer to ascertain that no detail of maintenance had been overlooked and which would place him in a position to analyse results and form a definite picture of the condition of his equipment.

London, W.5. JAMES WELFORD.

Lightning Effects

WITH reference to the letters from Mr. G. N. J. Rogerson and Mr. E. A. Pinto in your issues of September 24th and November 26th, the Thunderstorm Survey has been continued all through the war years and full data have been collected. Analysis and mapping are proceeding only slowly on account of shortage of staff, but it is intended to resume publication of the thunderstorm distribution charts as early as possible after the war and to make the results available to electricity and planning undertakings in the usual manner.

The basic maps are drawn up by a special method and cover the whole of the British Isles; the initial maps show the storm areas on individual days and final maps for calendar quarters and years are built up from these. The amount of collected data has now made possible the construction of local maps for individual undertakings covering periods of ten or twelve years.

Huddersfield. (MRS.) F. E. BOWER,
Acting Director,
Thunderstorm Census Organisation.

Domestic Apparatus Ratings

MUCH consideration has been given to the improvement of electric wiring and provision of adequate plug and socket outlets, etc., to meet domestic electrical requirements, after the war. Apart from the practical advantages which such improvements may bring, there remains the aspect of electrical ignorance on the part of the average domestic consumer. Is it not advisable to create a better understanding, which will come from simplified knowledge of the uses of household electrical supply?

Most people have a sense of familiarity with the term "volts" and, in a much lesser degree, "watts" or "kilowatts," because of the more frequent application of these words in connection with lamps and domestic appliances. The term "amps," however, causes some bewilderment. The householder is confused by a practice which describes switches, sockets, fuses and even cables in terms of voltage and current, whereas lamps and domestic appliances are identified by voltage and power consumption.

May I suggest that the latter terms of description be used where type definition is required, *e.g.* the 5-A socket becomes a 1,000-W socket. There are minor complications to be met on account of variations in voltage in different localities, but these would not appear a serious obstacle to the object in view.

*Greenwich, S.E.*10. R. F. HARVEY.

House Wiring Schemes

I AM in agreement with Mr. Raynor's suggestion in your issue of November 19th that a quick-acting h.r.c. cartridge fuse of 10-A rating embodied in a plug would give better protection for portable appliances than is at present generally effected with wire fuses. The adoption of a 10-A fuse, as Mr. Gilbert points out, is contrary to existing regulations and may cause some opposition, but only from theoretical considerations.

No matter how perfectly a domestic installation is fused by rewirable fuses when the contractor leaves it, we cannot assume that the householder will look up the I.E.E. Regulations and rewire a blown fuse with 38 SWG, 35 SWG, etc., wire, as the case may be. Even in the extremely unlikely case of a very heavy overload on a small current circuit, a 10-A fuse with a fusing factor of 1·6 will give adequate protection for any flexible for 3 A or greater, as shown by Mr. Forbes Jackson. If a mistake-proof method of fuse protection for portable appliances can be evolved, which is economical and simple, why not adopt it? One such method is a standardised fused plug embodying a 10-A fuse.

The suggested use of small circuit-breakers instead of main fuse-switches is open to criticism, because of their relatively slow action and poor rupturing capacity. Unless they are backed up by quick acting h.r.c. fuses, their use might lead to more frequent blowing of the supply authorities' main fuses, with resultant delay and inconvenience.

Audenshaw. F. E. RYDER.

Aswan Dam Scheme

REFERRING to the article in your November 26th issue, page 720, dealing with the Aswan Dam Scheme, a paper which was read before the Vienna Sectional Meeting of the World Power Conference in 1938 by Dr. Abdel Aziz Ahmed Bey, Director-General of the Mechanical and Electrical Department of the Egyptian Ministry of Public Works, entitled "Hydro-Electric Power Developments on the Nile," gave later details of the proposals.

Roughly the Aswan proposal was a ten-year plan and covered the construction of a power station of 340,000 kW. The first stage would comprise five 48,000-HP Kaplan turbines. The second stage would be a duplicate of the first, each stage, with interest during construction, costing about

£E3,300,000 with a probable ultimate output of 2,000 million kWh. It was also anticipated that the cost per kWh generated would be about 0·047d.

St. Helens. W. A. HATCH, M.I.E.E.

Educational Broadcasting

THE addition of a third main channel of broadcasting through which all the B.B.C. educational activities could be directed was suggested in a recent paper read by Mr. Stuart Hibberd before the Royal Society of Arts.

It is my opinion that such a scheme would be of the utmost value in the early post-war period to those whose training and education had been interrupted by the war. Courses of lectures by eminent engineers would help many to gain a wide knowledge of the events and trends in the various branches of electrical engineering more quickly than through the usual channels alone. They would also be of great assistance in bringing modern ideas and practices before those who have passed their student days.

Lydney, Glos. O. R. JONES.

Salary Disparity

THE Newport and Edinburgh advertisements for chief electrical engineers should act as a warning to members of the supply industry.

It may be that many more authorities will follow their example, unless steps are taken to make the remuneration of deputy chief engineers reasonably comparable with the chief engineers' schedule.

NOT AN APPLICANT.

Supply in Portugal

National Board's Report for 1941

THE progress of the electricity supply industry in Portugal is comprehensively surveyed in the 380-page annual report for 1941 of the Portuguese Board of Electrification, a copy of which we have received from the chief engineer.

The report shows that the total production for the year amounted to 479·5 million kWh as compared with 460 million kWh in 1940, an advance of about 4·2 per cent. (as against 2·7 per cent. in 1940 and 5·2 per cent. in 1939). The total number of power stations in the country both hydro-electric and thermal, is 654 and their aggregate capacity is 279,830 kW, these figures comparing with 660 and 280,820 kW a year before. The decrease of six in the number of stations was due to the closing down of old hydro-electric and thermal plants of relatively small capacity. Several new stations are in course of construction while plans for a number of others are being prepared and are to be proceeded with as soon as circumstances permi

Hydro-Electric Plants

Altogether water power was responsible for about 40 per cent. of the total output in 1941. Hydro-electric plants numbered 108 with an aggregate capacity of 83,405 kW and an output of 191·4 million kWh. Thermal plants numbered 546 (196,425 kW) of which 128 (139,584 kW) were for public supply.

Of the total of 178 public supply plants 150 generate AC and 28 DC. On the other hand, out of 476 private electricity supply stations 244 produce DC.

A feature of the thermal power stations is the increasing use of Portuguese coal, due to the shortage and dearness of imported coal. Thus the report shows that native coal used rose from 91,300 tons in 1939 to 142,152 tons in 1941.

The consumption of power throughout Portugal amounted to 404·6 million kWh. Just over 20 million kWh was used in the power stations themselves, while transmission losses amounted to 55 million kWh. A table shows that 23·3 per cent. of the consumption was utilised for lighting, 15·9 per cent. for traction, 55·3 per cent. for power and agricultural uses—in which class the textile industry, using 79·7 million kWh, was the largest consumer—and 5·5 per cent. by the electro-chemical and metallurgical industries.

Most of the public utility generating stations in the country are of relatively small capacity, there being only nine with plant totalling over 5,000 kW and the capacity of these nine aggregated 165,070 kW. The largest undertaking in the country is the Companhias Reunidas Gas e Electricidade of Lisbon, whose Teje steam-operated station has a capacity of 73,990 kVA; its output during 1941 was 123·7 million kWh. Of the private supply stations only one has a greater capacity than 5,000 kW.

Owing to higher prices and the difficulties in obtaining supplies, as a result of the war, only about 135 miles of new high-voltage transmission lines were constructed during the year, making the total length of the country's system 3,666 miles, mainly overhead and supported on steel masts.

Finally, it may be mentioned that the number of accidents at Portuguese electric power stations reported during 1941 was 42 (seven more than in the previous year) causing the death of 29 persons and injuries to 20 others.

New Minimum Charge Order

MAJOR Lloyd George, Minister of Fuel and Power, announced in the House of Commons on Tuesday last that he had decided to amend the Order relating to minimum charges by electricity supply authorities. The new Order will provide that the minimum charge for flat-rate consumers shall not exceed 10s. per annum instead of 25s. as at present.

PERSONAL and SOCIAL

News of Men and Women of the Industry

THE Minister of Fuel and Power (Major Lloyd George) announces that **Lord Hyndley,** who is retiring from the position of Controller-General of the Ministry at the end of this year, is to continue to act as chairman of the Coal Sub-Committee of the London Committee of the Combined Production and Resources Board. **Mr. J. Eaton Griffith,** O.B.E., has been appointed a Principal Assistant Secretary in the Ministry and will occupy the position of Chief Administrative Assistant to the Controller-General (Dr. H. S. Houldsworth, K.C.).

Mr. T. Scott has joined C. H. Parsons, Ltd., as their sole representative for Scotland. After volunteering for the Forces at the outbreak of the war and serving in the Middle East, Mr. Scott has been discharged. Before the war he was on the staff of the Revo Electric Co.'s Glasgow branch.

Mr. W. H. Walton has been re-elected chairman of the Executive Committee of the Electrical Contractors' Association and **Mr. H. M. Drake** is to be deputy-chairman.

Mr. O. F. Bailey, principal of the College of Technology, Northampton, is president of the newly formed Northampton and District Electrical Association which recently held its first meeting.

Mr. A. Buckingham (North Canterbury) succeeds **Mr. J. A. Smith** (Horowhenua) as president of the Electric Supply Authority Engineers' Association of New Zealand. In his presidential address Mr. Smith surveyed the progress of electricity supply in the Dominion. The honour of having the first plant for a public supply belonged to Reefton, he said. There, in 1887, within five years of the commencement of the first systems in America and England, the supply was started by means of a 20-kW Crompton bi-polar dynamo, 30-110 V, belt driven from a water turbine with a head of 7 ft. In 1892 a steam station with 300 kW of plant was erected in Wellington. The supply (2,000 V, 80 cycles single-phase) was distributed to pole transformers and stepped down to provide a two-wire 105-V supply to consumers.

The new president of the Electric Power Boards' and Supply Authorities' Association of New Zealand is **Mr. J. A. Nash** (Manawatu-Oroua) and **Mr. N. M. Speer** (Auckland) is president of the Secretaries' Branch.

Mr. J. M. Fleming (Wellington) has been re-elected president of the New Zealand Electrical Traders' Federation.

Obituary

Mr. A. Home-Morton.—It is with great regret that we learn of the death of Mr. Andrew Home-Morton on December 5th, less than a week after the publication of the memorandum on reorganisation by the Incorporated Association of Electric Power Companies which bore his signature as secretary.

Mr. Home-Morton was educated at St. Paul's School, London, the King Edward VI School, Birmingham, the Royal Technical College, Glasgow and the Glasgow University. He served an apprenticeship with Tangyes, Ltd., and then became assistant to his father, David Home-Morton, who was a consulting engineer; he later became a partner in the firm of D. & A. Morton, and as a consulting engineer and works designer was responsible for the lay-out and equipment of many important industrial establishments.

In 1922 and 1923 Mr. Home-Morton held a position with the Nestlé and Anglo-Swiss Condensed Milk Co. and was then for about nine years managing director of the Hoffmann-la Roche Chemical Works. In 1933 he resumed his consulting practice, becoming secretary of the Joint Committee of Electricity Supply Associations and assistant secretary of the Power Companies' Association in 1936. He succeeded Mr. A. de Turckheim as secretary of the latter Association in 1938. In that capacity he contributed an article upon the Association to the *Electrical Review* of July 21st, 1939, which was one of the series on "Organisations of the Industry" which we were then publishing.

Mr. Home-Morton was a member of the three premier engineering institutions and was prominent in public affairs in Southgate and Middlesex. He was also until recently joint secretary of the Joint Committee of Electricity Supply Associations.

Mr. S. R. Black.—The death has occurred in Glasgow of Mr. Sydney R. Black, B.E.M. Mr. Black was well known in the shipping world for the many trial trips on which he represented Kelvin, Bottomley & Baird, Ltd., as their senior adjuster. He succeeded to this position in 1929 on the death of Mr. R. W. Baird, after being Mr. Baird's assistant for 21 years. Among the more notable vessels which Mr. Black adjusted were the *Queen Mary* and the *Queen Elizabeth*. He was fifty-seven years of age.

Mr. W. Swan.—The death occurred on December 5th, at his home in Surbiton, of Mr. William Swan, a former superintendent of the Eastern Extension Telegraph Co.

Sir Daniel Naylan, chairman of Fescol, Ltd., has died at Hove at the age of 74.

Linesman's Death

AN inquest was held at Blackpool on December 2nd on Ernest Williams (48), electric linesman, of Preston, who was killed at Marton electric switch house. Mr. G. A. Robertson, borough electrical engineer of Preston, said that a senior officer should have ensured that everything was "dead" before work was started. The officer in question thought that the bars were dead, but he should have closed the isolator and made sure. They had always found him a very careful and conscientious worker and had the greatest faith in him. The coroner returned a verdict of "Death by Misadventure."

East African Markets

Results of Wartime Restrictions

Tanganyika

THE following table, which is based on the recently issued trade returns of Tanganyika for 1942, shows the imports of electrical goods in that year, by countries, with a note of increase or decrease compared with 1941.

It will be seen that there was a marked decline on balance in the electrical group, the only exceptions being power plant, portable appliances and telegraph and telephone equipment, other than radio. The decrease in imports generally is explained by the Acting Comptroller of Customs in his report as a natural consequence of a policy aiming at the reduction of imports to bare essentials and, to a less extent, of enemy submarine activity. He adds that heavy increases in direct and indirect taxation, imposed in December, 1941, have reduced local purchasing power. The Comptroller considers it inevitable that with the tightening of controls and the ever-increasing difficulties of supply, there will be a further decrease in imports.

Class.	1942 £	Inc. or dec. £
Accumulators and batteries—	6,000	− 6,200
From Britain	5,500	− 2,800
„ South Africa	200	− 800
„ Canada	100	− 600
„ United States	150	− 1,450
Cable and wire—	3,800*	− 700
Dynamos, motors and rotary convertors	4,200	+ 2,800
From Britain	3,900	+ 2,600
„ United States	200	+ 100
Lighting bulbs and tubes, domestic—	900*	− 600
Ditto for flashlights and handlamps—	90	− 110
From Britain	50	− 90
„ Hong Kong	19	− 16
Other lighting bulbs and tubes—		
From Britain	140*	+ 130
Portable or domestic tools and appliances—	550*	+ 480
Telegraph and telephone instruments and apparatus—	800*	+ 410
Radio receiving sets, complete—	2,500	− 2,200
From Britain	2,200	− 1,000
„ South Africa	100	− 130
„ United States	140	− 720
Other radio apparatus—	1,300	—
From Britain	60	− 490
Other elec. machinery, goods and apparatus—	15,000	− 9,800
From Britain	13,200	− 9,400
„ Hong Kong	200	− 800
„ United States	1,400	+ 600

* All or mainly from Britain

With the object of raising the standard of living of the natives the British and local Governments are doing everything possible to supply Tanganyika with medical, welfare, educational and other technical staff.

Kenya and Uganda

The foregoing remarks regarding recent and prospective imports into Tanganyika apply in great measure to Kenya and Uganda. There the principal wartime development has been the increased production of sisal and pyrethrum.

In Kenya, where Government finances are in a sound condition, there are projects for soil conservation, at a cost of nearly £1,000,000, and for the housing of Africans, on which £500,000 would be spent. There are also schemes for water supply and reafforestation. Further, a five-year construction programme is in preparation.

Class.	1942 £	Inc. or dec. £
Electric light bulbs—	8,900	+ 1,390
From United Kingdom	8,800	+ 1,600
„ United States	10	− 90
Torches—	3,500	†
From United Kingdom	1,800	
„ South Africa	1,500	
Lighting accessories and fittings—	10,600	− 3,400
From United Kingdom	8,300	− 5,200
„ United States	300	+ 2,050
Electric wires and cables—	74,000	+ 56,300
From United Kingdom	71,500	+ 54,700
„ United States	1,500	†
Telegraph and telephone instruments and apparatus—	12,900	− 200
From United Kingdom	12,200	− 700
„ India	500	+ 500
Radio apparatus—	15,200	− 10,500
From United Kingdom	11,500	− 6,900
„ United States	2,300	− 1,900
Elec. goods and apparatus not elsewhere specified—	11,800	− 21,200
From United Kingdom	11,100	− 6,300
„ United States	500	− 500
Elec. machinery and parts—	40,000	+ 5,000
From United States	10,600	− 800
„ United Kingdom	28,500	+ 5,500

† Comparative figures not available

In the accompanying table are given the values of electrical imports in 1942, with a note of increase or decrease compared with 1941. The only noteworthy increases were in cables and lamps, against which there was a marked decrease in radio apparatus and unspecified electrical goods.

"Economic Equity"

THE above is the title of a group which has been formed to advocate the adoption of a "science of physical economy" which seeks to divorce production and consumption from "money" in the generally accepted sense of the term.

Among the fourteen reforms put forward in a "Charter of Economic Equity" (price 2s. 2d., including postage, from Economic Equity, 26, Stafford Court, Kensington, W.8) is the public ownership of essential utility services, coupled with the full utilisation of natural power resources for the benefit of the community. Among the signatories we note the names of Mr. E. A. Logan, M.I.E.E., and Mr. C. A. Cameron Brown, A.M.I.E.E.

The group held an exhibition last week of designs and models of houses and flats of the types which it is claimed are made economically possible under the advocated system.

COMMERCE and INDUSTRY

Firm's Scheduling Cancelled. Retail Trading Licences.

Reinstatement of Employee

IN a written reply to a Parliamentary question the Minister of Labour and National Service stated last week that he proposed to cancel the certificate of scheduling under the Essential Work (General Provisions) (No. 2) Order, 1942, of Desoutter Bros., Ltd., Hendon. This company was ordered, on October 26th, to reinstate a Mr. V. G. Jackson in his former employment. It maintained that it had no work for him but paid him his wages. Another worker was withdrawn from the company to enable it to give work to Mr. Jackson and a further direction was issued with which the company had not complied.

The Minister pointed out that the cancellation of the certificate would mean that the company's skilled labour could be directed to other concerns and that material could be withheld. At the same time the company would be free to dismiss employees if it wished to do so. This was the first case of the cancellation of a certificate.

Sale of Electric Torches

Replying to a question in the House of Commons on December 1st the President of the Board of Trade stated that in the Schedule to the Location of Retail Businesses Order, 1942, there were separate categories for electrical torches and batteries and for electrical goods and appliances (other than torches and batteries). If a trader wished to deal both in electrical goods and in torches and batteries he must apply for a licence for both categories. He saw no reason to revise this Order.

Swansea and J.I.C.

The question of rejoining the District Joint Industrial Council was considered recently by the Swansea Electricity Committee. Mr. H. E. Blackiston, chief engineer and manager, stated that as the Committee had to comply with the rates and conditions applied by the J.I.C. it should have a say in what they should be. Consideration of the matter was deferred.

New Luton Appointments

Luton Town Council has agreed to appoint a consumers' engineer in the Electricity Department, at a commencing salary of £600 a year, and a technical assistant engineer at a commencing salary of £333 a year, both appointments to be permanent. The decision followed a report to the Electricity Committee by the borough electrical engineer expressing concern at the shortage of staff in certain important categories.

"Suggestion Box" Proposal

A proposal by Luton Electricity Committee to introduce a "suggestion box" at the undertaking in order to increase the interest of employees was approved by the Town Council after a lengthy discussion. The borough electrical engineer stated that similar schemes had been operated with great success in manufacturing concerns and it might well be that in this case some useful suggestions would emerge. A payment of 5s. is recommended for any new suggestion adopted. In cases where suggestions are of special merit further amounts will be paid, depending upon the results obtained.

Lamp Manufacture in New Zealand

The first New Zealand factory for the manufacture of electric light bulbs was established in Auckland in 1938, and a second commenced production in Wellington two years later. According to the *N.Z. Electrical Journal*, these two factories now make 3,000,000 lamps annually and by the end of the war are expected to be producing twice as many.

Telecommunication Association

A new organisation named the Telecommunication Engineering and Manufacturing Association has been formed "to promote the interests of the industry, to maintain the highest possible standard of telecommunication equipment and to facilitate, whenever required, collaboration with Government Departments on matters of national concern." It is thought that the new body, without overlapping the activities of any of its older colleagues, will fill a gap which has been, until now, rather conspicuous in the general organisation of our national industrial and manufacturing framework. Mr. T. G. Spencer (Standard Telephones & Cables, Ltd.), has been appointed chairman, with Mr. T. A. Eades (Automatic Telephone & Electric Co., Ltd.) vice-chairman. The secretary is Mr. H. E. Powell-Jones, who is also director and secretary of the Telephone Development Association. The offices of the Association are at Aldine House, 10/13, Bedford Street, Strand, W.C.2.

Radio at War

To demonstrate to employees that their own particular job really is of value to the war effort, even if it is sometimes a little monotonous and irksome, Bush Radio, Ltd., in collaboration with the Ministry of Supply, has arranged an interesting exhibition showing the increasingly important part played by radio in wartime. After tracing the transition from peace to war, the display surveys, by means both of photographs and actual instruments of war, the various and innumerable applications of radio to-day.

The first portion of the exhibition deals with the defensive side—its use in observer posts, raid warnings, countering the U-boats, direction and control of fire-power of ships, radiolocation, anti-aircraft defence, direction of aircraft, fire-fighting, the evacuation from Dunkirk and the Battle of Britain. Passing over to the offensive, new applications to which attention is drawn include the control of landing craft, tanks, transport lines, bombers, paratroops, etc. Among the weapons on view are a predictor, an aeroplane engine, an Oerlikon anti-aircraft gun, a damaged Flying Fortress wing,

a searchlight, armour-piercing shells, rubber dinghies and their equipment.

A special section of the display shows how the company's radio equipment has been developed to its present stage of efficiency. Until December 21st workers in the Bush factory, their friends and representatives from other firms will have an opportunity of seeing the exhibition. Receipts from a small charge made for admission are going to the Soldiers', Sailors' and Airmen's Families Association.

Soldier Killed While Ploughing

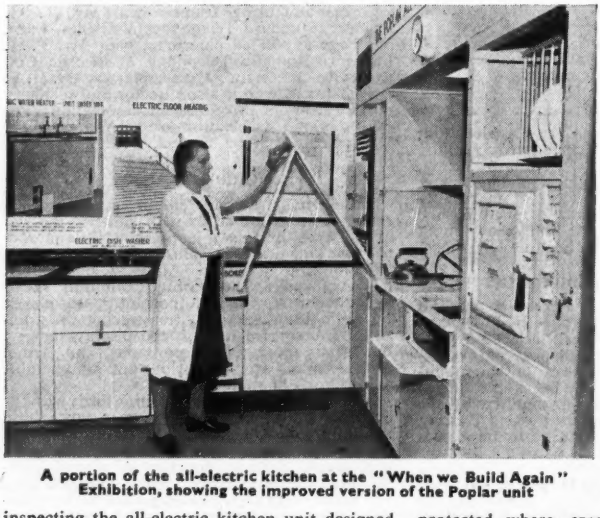
A verdict of "Accidental death" was recorded at an inquest held on Pte. Percy Rees Matthews (23), who was killed while ploughing up a vegetable plot with a tractor. The machine apparently struck the guy wire of an electricity supply pole. Capt. R. E. S. Jones, who came running to the spot, was thrown to the ground when he touched the wire.

Air-Blast Switchgear

In referring to the English Electric Co.'s publication sg/105 in our November 26th issue the breaking capacities of circuit-breakers of the axial blast type were given as up to 1,500 kVA; this should have read 1,500 MVA.

Post-war Building Exhibition

The "When We Build Again" Exhibition, which the Town and Country Planning Association, in collaboration with Cadbury Bros., Ltd., is holding at Heal & Son's stores, 196, Tottenham Court Road, London, until December 18th, gives the public an opportunity not only of inspecting the all-electric kitchen unit designed by Mr. Robert Illingworth, borough electrical engineer of Poplar, but also comparing it with the kitchen arrangements planned by the gas industry. Since we described the Poplar unit in our issue of July 16th, various improvements have been made in the design, including the provision of an electric clock and the incorporation of a 20-gal. water heater in the space originally left for accommodating a wash boiler. Both the wash boiler and a combined dish washer and sink refuse disposal unit are arranged separately in the exhibition kitchen. On all scores—appearance, convenience and labour saving, the electric kitchen need fear no comparison with its gas counterpart, the main feature of which, a separate utility room, with alcove for washing and drying clothes, is probably an advantage where there are gas fumes.



A portion of the all-electric kitchen at the "When we Build Again" Exhibition, showing the improved version of the Poplar unit

New Uses for Cement

A variety of new uses for cement that have been developed to meet wartime requirements were illustrated at an exhibition held by the Cement and Concrete Association at the Royal Empire Society, London, on November 23rd. The applications and advantages of prefabrication demonstrated were of particular interest to those interested in post-war buildings and their equipment.

What was Right?

A New Zealand electrical worker charged with offences in connection with the installation of electrical conductors and accessories in four premises was fined £20 with £6 4s. costs. According to the *New Zealand Electrical Journal*, the supply authority's report on the work was as follows:—

On one installation there was no earthing clip. There was no neutral bar on the sub-board. There were no fuses on the sub-board. The wood casing was not carried to the back of the sub-board and there was no capping on part of the wood casing. The conduit for the garage light was not earthed. Two cables from the main switchboard to the new work were not in casing for a distance of 30 ft. The conduit for the water heater sub-cicuit was broken at the coupling and the wire was damaged. The conduit in the roof was not saddled.

On another installation the main earthing-lead was 3/·036 and it was jointed. A lead-headed roof nail was driven into the casing. The flexible conduit was not secured to the block. The casing in the wash-house was not painted. The casing was not supported or fixed properly and it was not protected where crossing a manhole. The capping was not completed at the switchboard. There was a damaged switchblock in the wash-house. No shrouds had been fitted to the all-insulated lampholders.

On a third installation the cable to the first

plug-socket on a sub-circuit for two plug-sockets was 3/·029. A three-pin plug-socket was not connected up correctly. A block for a switch and some surface casing were loose. The casing in the wash-house was not painted. No shrouds had been fitted to the all-insulated lampholders. On the fourth installation the conduit for an aerial circuit was split.

Help for Stalingrad

A cheque for £508 has been sent by the employees of Thorn Electrical Industries, Ltd., and their associated companies, Ferguson Radio Corporation, Ltd., and Lamp Presscaps, Ltd., to the Joint Committee for Soviet Aid for the provision of beds in the Stalingrad Hospital. This money was raised entirely by the efforts of the employees who organised dances, raffles, collections, etc. In addition to this cheque a message of greeting is being sent to the people of Stalingrad, inscribed in English and Russian, with many hundreds of signatures appended.

The Electrical Association for Women branches have shown such interest in the fund to provide beds in the Women's Wing of the Stalingrad Hospital that already enough money has been contributed for one bed. The North Western Area has very nearly enough for a second bed, and it is probable that a third bed will be provided.

Grading of Engineering Workers

No decision was reached at a conference in London last week between the engineering unions and the Engineering Employers' Federation on the question of further grading in the industry. An official statement issued at the close said that the employers had undertaken to examine the unions' case and that the conference would be resumed at an early date.

The unions, it is understood, wish to secure a larger number of grades so as to provide for more flexibility for labour. The employers are not believed to have any strong objection to the regrading scheme, but think that there may be some practical difficulties in the way of drawing up a national agreement which would be applicable to every firm in the country, owing to the varying nature of the work, the labour, and the types of machines.

Combined Kitchen and Bathroom Unit

Several schemes for comprehensive kitchen units comprising all essential equipment have already made their appearance. The idea of prefabrication is carried a stage further by Mr. Charles E. Elcock, F.R.I.B.A., 2, Bedford Square, W.C.1, who has incorporated on the reverse side of his proposed unit complete bathroom and lavatory equipment, including an electric clothes washer and dryer under the wash basin. The kitchen portion of the scheme provides for a row of cupboards at the top and below, from left to right, a sink with cupboard beneath; a refrigerator with draining board on the top; vegetable store and drawers for cutlery, etc.; an electric cooker; and a water heater with hot water tank above. All the electrical wiring and plumbing are carried to convenient connection points at the end of the unit, thereby greatly facilitating installation.

The unit has been designed primarily as a component for use in prefabricated houses and bungalows. One design for the latter which Mr. Elcock has prepared comprises a living room 16 ft. 2 in. by 11 ft. 4 in., and three bedrooms. If the concrete foundation were constructed beforehand and provision made for the various services, it would be possible to erect the building and render it ready for occupation easily within a day. The cost would be about £600 complete at present-day prices (or £450 if constructed in bulk). Allowing a life of twenty-five years and including kitchen unit, maintenance and management, but excluding rates, it could be let at 13s. 6d. per week.

Peacetime Benefits of Wartime Research

Four displays now to be seen on the façade of Magnet House, London, are symbolic of future development and in particular of G.E.C. research, rather than of past or present achievements. They indicate that the full benefits of wartime research, now directed towards the successful prosecution of the war, will only be obtained when the additional knowledge of those relatively unknown quantities, radium, ultra-violet rays and infra-red rays, can be applied to improve the health, outlook and surroundings of a community at peace.

These displays are of the three-dimensional type carried out in bold and contrasting colours.

Factory Exhibition

In conjunction with the Directorate of Public Relations, Ministry of Supply, David Brown & Sons (Huddersfield), Ltd., have recently held an exhibition at their main works, showing the products of the organisation. It was opened by the Princess Royal on November 12th and has been well attended by workers and their families. Opportunities were also afforded to the pupils of a number of technical schools in the district to visit the exhibition and most of them were keenly interested in the different methods of obtaining speed variation on the various types of gear boxes which were shown opened up.

N.Z. Praise for British Manufacturers

Commendation for United Kingdom electrical manufacturers is given in the annual report of the United Kingdom Manufacturers and New Zealand Representatives' Association. Electrical power machinery, the report states, has been arriving from the U.K. in a manner that is truly remarkable and under the circumstances eminently satisfactory, so that it would commend the U.K. manufacturers of electrical equipment most heartily on the wonderful effort they have made to meet the Dominion's requirements, in addition to the important contribution they are making in the war effort. The post-war period in so far as New Zealand is concerned will usher in many years of prosperity for the electrical industry, and the extent of the immediate recovery will be largely governed by the abolition of existing restrictions on the importation of electrical power plant and appliances, coincident with post-war reconstruction.

Changes of Name

The names of the following companies have been changed :—

MANCHESTER INSULATING CO., LTD., Manchester, to the Manchester Insulating & Electrical Co., Ltd.; and S.D. & T. ELECTRICAL, LTD., to Sid Dagnall & Son, Ltd.

Industrial Fire Risks

Electrical Apparatus Safeguards

EXCLUDING damage from enemy action the loss due to fires in Great Britain in 1942 reached £12·5 million compared with an annual average of £9·3 million for the eight years immediately before the war. The increase is attributed by Messrs. W. Fordham Cooper and F. H. Mann (Factory Department, Ministry of Labour), in a paper read on December 9th before the I.E.E. Installations Section, largely to special wartime processes. Although the proportion due to electricity may be small, some vital processes are peculiarly susceptible to fire risks due to the use of improper electrical apparatus or to the development of electrical defects. A selection of the instances cited is given below.

The first part of the paper deals in considerable detail with general principles and the second part with their application. Flameproof apparatus is divided into three groups of standards. Group 1 (Methane) is for mining and Group 2 (Pentane) covers the majority of industrial requirements, including places where petrol, benzine or acetone and most cellulose solvents are used, Group 3, the highest rating, originally intended to cover risks due to town's gas is also required for electrical apparatus in the presence of coke oven gas.

Incorrect Fusing

The majority of fires of electrical origin are associated with short-circuits. Many are due to over-fusing, including inadequate sub-division of circuits and the use, in unsuitable circumstances, of fuses that are capable of carrying several times their rated currents before they clear. Such a fault may be associated with defective earth continuity, causing high local temperatures.

With some high explosion risks (*e.g.*, magnesium-powder grinding) the building should be provided with pressure relief on a generous scale and flameproof electrical equipment, made dust-tight by grease on the flanges. Oil-immersed apparatus should be excluded from processes involving the use of potassium and other chlorates as these explode in the presence of organic matter; motor drives should be taken through a stuffing gland in the wall. Since cellulose spray can travel along the spindle of a ventilating fan, the motor should be flameproof. This applies also when naphthalene is used as a solvent, in which case the elimination of voids in compound in cable boxes is especially necessary to prevent tracking of open ends of paper- or cambric-insulated cables. Some new plastic insulating materials, such as polyvinyl chloride, which are chemically inert, should prevent this trouble. Installations in fine-chemical works, where processes in any section may be varied at short notice, should comply with the requirements of Group 3.

In petroleum refining there is considerable scope for intrinsically safe telephones, bells and inspection torches for examining vessels. Meticulous attention to earth continuity and bonding of apparatus is essential; the breaking of a pipe joint through which a stray current is flowing is a particular danger.

It is still difficult to obtain a connector for a heavy iron that is sufficiently heat-resisting for continuous use, and short circuits at the cord grip are not infrequent. The use of flexible cable with inflammable binding is to be deprecated even if asbestos-wrapped. Plain t.r.s. cable with or without hard-thread braiding moulded on to the rubber has proved fairly satisfactory.

Precautions in Sawmills

All circuits in crane cabs should be independently protected and should incorporate the minimum of inflammable material. Cables should be screened from external heat sources. Sawmills and cabinet works should be wired in heavy-gauge screwed conduit or the equivalent, and open conductors at the entry to motor starters should be eliminated.

Adequate overload and earth-leakage protection should be provided for luminous-discharge tube signs. No fewer than thirty fires were recorded in the London area during six months before the war owing to leakage current in damp situations, loose connections and sparking; the high-voltage conductor supports should be non-ignitable.

In transformer chambers below blocks of buildings the structure should be capable of resisting the effects of fire for a considerable period, and independently ventilated. Undue rise of temperature should be indicated and means for remote disconnection of the high-voltage supply should be provided. There should be fixed automatic fire extinguishing equipment. An emergency lighting supply is desirable. Air-break switchgear and air-cooled transformers have contributed towards combating the fire hazard.

A hand lamp should not be introduced into an emptied transformer oil tank until any inflammable vapour has been removed by ventilation. The greatest attention should be paid to the settings of protective gear and the maintenance of earth continuity.

Reactive Currents

Cancellation of Components in Three-Phase Systems

By G. W. Stubbings, B.Sc., A.M.I.E.E.

THE conception of active and reactive components of the current in a single-phase AC load, although strictly speaking a mathematical fiction, is, nevertheless, satisfying to practical engineers because it is possible to construct or at least to conceive an exact copy of any single-phase load in which these component currents appear objectively in parallel circuits. A lagging active component is always associated with an alternating magnetic field, and a leading reactive component with an alternating capacitative charge, and conversely. The reactive component in an AC combines with the supply voltage to produce oscillating power of zero average value; hence the designation "wattless."

Reactive component current reduces power factor and increases the phase difference between actual current and voltage; if lagging, it can be annulled by an added artificial capacity load and, if leading, by added reactive load. It also increases the loss in the conductors supplying the load per kW of power, and as the square of the actual current is equal to the sum of the squares of the active and reactive components, this loss equals the sum of the losses of the two components supplied separately.

Two Conceptions

A three-phase supply can be considered either as an assemblage of three component single-phase supplies, or as a single supply of a complex type. As three-phase supplies are produced in single generators each driven by its own prime mover, the latter view is the more rational one. The conception of reactive-component currents in a three-phase supply is not as simple as in the case of a single-phase load. If the three-phase supply is balanced (*i.e.* the aggregate of three identical single-phase supplies) the foregoing statements regarding single-phase reactive currents apply with one exception. The reactive component of a balanced system of currents does not in association with balanced voltages produce any oscillating power, because the magnetic field or the capacitance charge set up by these component currents is constant in magnitude. This reactive current is therefore literally wattless.

If a three-phase supply is unbalanced the conception of reactive-component currents is much more complicated. A low power factor of the component single-phase supplies of which the unbalanced load can be considered to be compounded may arise without the production of any magnetic field or capacitance charge, although there will be an oscillating component of the total power in the supply. Further, with these anomalous phase differences, the line loss per kW of power will be greater than that set up by balanced loading. Whether this kind of phase displacement, which increases line loss, is considered to reduce the power factor of the three-phase load depends entirely upon the way in which three-phase power factor is defined. As the power factor of a single-phase load can be made a maximum, and, hence, the line loss minimised, by the addition of an artificial reactive or capacitative load, so the anomalous phase displacements in an unbalanced three-phase load can be annulled and the line loss minimised by adding artificial load which annuls the unbalance. Whether, however, this can be called power factor correction, depends, again, upon the definition of three-phase power factor.

A rudimentary illustration in the case of an unbalanced three-phase load is shown in

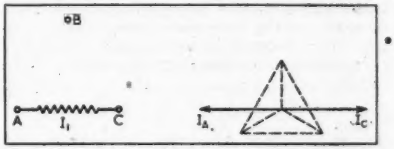


Fig. 1.—Rudimentary case of an unbalanced three-phase load

fig. 1, where a pure resistance is connected to two lines of a three-phase supply from which a current of I amperes is taken. The power input is IV watts, and the power factor of the load seems to be unity. The loss per ohm of line resistance to supply load is, however, $2I^2$ and if the same load were supplied by balanced currents, each of these currents would be $I/\sqrt{3}$ A, and the total line loss per ohm would be I^2, or one half that of the load of the circuit. Regarding this load as the aggregate of two component single-phase loads, then in each of these components there is a 30-deg. phase difference between line current and the associated star voltage, so that, in a sense, the power factor of the load is less than unity.

One method of annulling these phase differences of line current and star voltage is shown in fig. 2. Here a capacitance is connected between A and B phases and a pure reactance between C and B phases, and the impedances of these added components are each equal to $\sqrt{3}$ times that of the resistance. The vector

diagram shows that the leading current in the capacitance combines with the resistance current in the A line to produce a resultant in phase with the A star voltage. Similarly in the C line. The resultant of the currents in the capacitance and the reactance is in phase with the B star voltage.

The resultant system is balanced and consists of three currents each equal to $1/\sqrt{3}$ times the current taken by the single circuit of fig. 1. The power inputs to the two circuits are the same, and in each case the power factor is unity. The line loss for the fig. 2 load is one half that for the fig. 1 load and its unity-power-factor load contains lagging and leading VAr components.

The usual answer to the question as to how a three-phase load containing actual reactive components can be of unity power factor is that the leading VAr in one component are cancelled by the equal lagging VAr in the other. Evidently this is not really so. Although the addition to the load of fig. 1 of equal leading and lagging VAr components has not altered the nominal power factor, it has radically changed the character of the load, in that it has reduced the line current per kW and, hence, the line loss to supply this load.

An explanation of this paradox is provided by the theory of symmetrical components. The single phase load of fig. 1 consists of equal positive- and negative-sequence components, and if the three-phase supply voltages are balanced, the negative-sequence component is wattless, in that the whole of

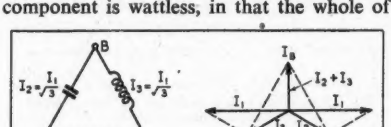


Fig. 2.—Method of annulling phase differences of line current and star voltage

the power is carried by the positive-sequence component. The effect of adding the reactive and capacitative components in the fig. 2 load has simply been to cancel and destroy the negative-sequence component of the currents supplying the fig. 1 load.

The vector diagram of fig. 2 shows that the currents in the added components, the reactance and the capacitance, combine to form a balanced system, but in this system the current I_2, which is supplied by A line, leads instead of lags one-third of a cycle on the current I_3, which is supplied by the C line. The negative-sequence balanced currents of the added components are in opposition to the same sequence currents of the load of fig. 1. The opposing negative-sequence components therefore cancel one another and the resultant current into the combination of fig. 2 forms a balanced load.

The foregoing illustration shows the manner in which a negative-sequence system of currents can be objectively produced and used to cancel the apparently fictitious negative-sequence current in an unbalanced load so as to convert this load into one which is balanced. This is analagous to ordinary power-factor correction but, as the VAr added to the original load consist of equal lagging and leading components, the nominal power factor of the original load consequently remains unaffected.

Result of Interchanging Connections

The added negative-sequence currents in the fig. 2 load have a definite phase relation to the star voltages of the supply. If the connections of the reactor and capacitance are interchanged, the currents into the combination will still be a balanced negative-sequence system, but its general direction will be reversed. Further, by making the common connection of the reactor and the capacitance to lines A and C, four other phase positions of an artificial negative-sequence system of currents can be obtained.

An artificial negative-sequence system of currents can be produced having any desired magnitude and any desired phase relation to the star voltages of the supply, and any unbalanced three-phase or converted load can be symmetrised into a balanced load of the same wattage and nominal power factor. This is possible because, as two balanced systems of currents of the same phase sequence combine to produce a resultant balanced system, by suitably choosing the impedance values of two component combinations, each consisting of reactance and capacitance like the added components of fig. 2, and by suitably connecting these two combinations to the supply, any required resultant can be obtained.

In a combination of this kind comprising two capacitance and two reactance units, one of each of these units must be connected to the same pair of lines, and therefore this pair of dissimilar units could be replaced by a single unit of the same admittance. Such a combination, which would annul a negative-sequence component, would have the same property as that used in the fig. 2 load; the algebraic sum of the VAr taken in it from the supply would be zero.

Thus, negative-sequence currents can be produced artificially and, hence, can be cancelled in actual unbalanced three-phase loads. Also the ordinary definition of three-phase power factor, according to which leading VAr in one phase are deemed to cancel lagging VAr in another, is not quite rational. Although practically convenient, this definition seems to have a limitation comparable with that in the text-book definition of the power factor of a single-phase load in terms of the cosine of a phase angle.

ELECTRICITY SUPPLY

Blackpool's Jubilee. Halifax Heating Proposal.

Birkenhead.—OBJECTION WITHDRAWN.—With reference to the formal objection against Liverpool Corporation supplying electricity to the Mersey Railway, the Ministry of Fuel and Power has informed Birkenhead Electricity Committee that a condition attaching to any consent is that such supply shall be for reasons of emergency only. Letters were forwarded from Liverpool Corporation and the railway company giving corresponding undertakings. In these circumstances the Committee decided to withdraw its objection.

KITCHEN INSTALLATION.—The Electricity Committee is to provide an electric heating service at the Rock Ferry kitchen at a cost of £225.

WORKS SUPPLY.—The Electricity Committee is to provide increased supply to Spillers, Ltd., at a cost of £1,600.

Blackburn.—NO REPRESENTATION.—The Electricity Committee has decided not to appoint any representatives on the Mid-Lancs Electricity District Advisory Board.

EXTENSION OF "STARLIGHTING."—Although modified lighting has only recently been adopted in the town it has proved so successful that the number of lights is to be increased from 153 to 507 forthwith.

EXTENSIONS.—The Committee is to supply electricity to several farms in the district at a cost of £540.

Blackpool.—UNDERTAKING'S JUBILEE.—To mark the jubilee of the Corporation electricity undertaking which was opened in 1893 by Lord Kelvin, President of the Royal Society, Alderman G. Whittaker, chairman of the Electricity Committee, entertained members to dinner on November 30th. Early days of the undertaking and its progress were the theme of congratulatory speeches. Blackpool's first Electric Lighting Committee was formed in 1891. In 1892 it was decided to borrow £26,000 to proceed with an electricity scheme. Lord Kelvin, opening the works, said that Blackpool had the honour of being in the forefront of progress. In 1879 Blackpool received an installation of 6,000-c.p. arc lights, erected on poles 60 ft. high, from the late Sir William Siemens. Sea water corrosion created difficulties. [This installation was described in our issue of October 15th, 1879.—Editors, *Electrical Review*.]

There have been four chief electrical engineers of the undertaking, namely, Messrs. J. Hesketh, R. C. Quinn, C. Furness and H. F. Shanahan, who is the present "chief."

Bromley.—PRICE INCREASE.—It is reported that the Town Council has approved an increase of 6 per cent. in electricity charges to come into operation on April 1st next.

Dumfries.—JOINT METER READING "IMPRACTICABLE."—The Electricity Committee, after considering the proposal for the joint reading of gas and electricity meters, has agreed that it would not result in the saving of labour and that the proposals are impracticable.

Guildford.—FIXED CHARGE REBATE.—At a meeting of the Electricity Committee the chairman reported that for the December quarter it had been found possible to give a rebate of 75 per cent. of the fixed charge to all consumers taking supplies under the "all-in" rate for domestic, office, shop and business premises, and that in all probability it would be possible to repeat this rebate for the March quarter. Similar rebates were allowed in the corresponding quarters of 1942-43.

FUEL ECONOMY AT DESTRUCTOR.—The borough engineer has reported to the Sanitary Committee that the amount of refuse collected is sufficient to keep the furnaces at the destructor works supplied for only 16 hours daily, and that for the remaining eight hours it is necessary to burn auxiliary fuel. He has suggested the installation of an electric motor at an estimated cost of £450 to drive one of the three steam plants during the night shift. This would save approximately 30 tons of fuel per week and dispense with the labour of two men. Allowing for the cost of electric power, there would be a saving of approximately £850 per annum. The Committee reports in favour of this proposal.

SUPPLY TO WORKS.—The Electricity Committee is to provide supply to the works of the Vulcanised Fibre Co. at a cost of £770.

Halifax.—WASTE STEAM FOR DISTRICT HEATING.—In the course of an address on flats and houses to a local women's organisation Councillor A. Pickles stated that consideration was to be given to the possibility of using waste heat from the electricity works for the central heating of many types of property. He disclosed that Dr. Faber, a London engineer with a wide knowledge of district heating, was to visit Halifax in January and would report on whether steam from the electricity works could be used in this way. Halifax was not so favourably placed as some towns because housing estates and blocks of flats were not very near the electricity works.

Hull.—ADDITIONAL PLANT.—The Electricity Committee is to install additional plant at a substation to meet increased demands at a cost of £1,337.

Newcastle-on-Tyne.—MODIFIED LIGHTING.—The City Emergency Committee proposes to introduce "starlighting" as soon as permissible. Other local authorities on Tyneside are also considering the matter.

Rawtenstall.—CABLE RECOVERY.—A letter has been received by the Electricity Committee from the Ministry of Supply to the effect that the question of redundant cables is to remain in abeyance for the time being.

PROTECTIVE DEVICES.—Additional protective relays are to be obtained and other steps taken to improve the protection afforded on the electricity distribution system.

Sheffield.—HOSPITAL KITCHEN EQUIPMENT.—The Health Committee has arranged for the Electricity Department to replace electrical cooking apparatus at the hospital at a cost of £224.

South Shields.—MODIFIED LIGHTING.—The Town Council is to order 200 electric lamps

in connection with the introduction of "star-lighting."

Wallasey.—RECOVERY OF REDUNDANT CABLES.—The Electricity Committee reports that it is not prepared, owing to the cost involved, to recover redundant cables, but has no objection to the Ministry of Supply doing so provided reinstatement is properly carried out.

Overseas

France.—ELECTRICITY ECONOMY MEASURES.—Paris Radio has announced that three measures to conserve electricity in France have been ordered by the Vichy Ministry for Industry and Supply. All industrial establishments must abstain from consuming any electricity whatsoever on Saturdays and Sundays and on certain days the electricity supply will be cut off from all private consumers between 9 and 11 in the morning and between 2 and 4 in the afternoon. Certain reductions have had to be made in Paris suburban electric train services.

Morocco.—NEW POWER STATION.—According to the Spanish journal *Metalurgia y Electricidad*, a new hydro-electric power station has been completed and put into operation on the River Talambot near Tetuan, in the Chuen region of Morocco. The capacity of the new station is not given, but it is stated that the various plants in the area are now able to produce over 10 million kWh per annum.

New Zealand.—CLAIM WITHDRAWN.—In May, 1942, we reported a case in which a writ was issued against the Auckland Electric Power Board by John Burns & Co., Ltd., who claimed £225,188 damages following a destructive fire at the company's premises. The company alleged that the Board had failed to fulfil its statutory obligations as set out in the regulations concerning electrical installations. It is now reported that the company has withdrawn its claim and has paid the costs.

Northern Ireland.—SECOND READING OF FINANCE BILL.—In the Northern Ireland Parliament the Prime Minister (Sir Basil Brooke) stated that the cost of the electricity interconnection with Eire had been paid in its entirety by the British Treasury. He was replying to questions during the debate on the second reading of the Exchequer and Financial Provisions Bill, which, *inter alia*, increases from £1,000,000 to £2,500,000 the sum of money which may be advanced to the Ministry of Commerce for the purposes of the Electricity (Emergency Supplies) Act.

Major Sinclair, Minister of Finance, said that the extra sum of £1,500,000 was not going to the Electricity Board. It would be spent by the Ministry of Commerce. The accounts would be submitted to the Auditor General and the Public Accounts Committee.

Mr. Johnston said that the House might be assured that any moneys voted by the House would be reviewed with the greatest scrutiny. He heartily approved of the Government's efforts to provide electricity adequate for the needs of Northern Ireland, for if the Government waited till after the war before providing electricity supply they would be from five to ten years behind the times.

It was stated by the Prime Minister that when the new power station was built the British Treasury paid roughly one half of the cost because the station was necessary for war purposes. The extra money was for the normal development of electricity in Ulster on the basis of additional power for industry.

The Bill was read a second time.

Spain.—MORE HYDRO-ELECTRIC PLANTS.—The Spanish journal *Revista de Formacion y Documentacion Professional* reports that the Sociedad de Saltos del Duero, which supplies a large part of the electric power requirements of Madrid, has prepared plans for the installation of six new hydro-electric plants. The largest, of 20,000 kW, will utilise the Sandin falls near Puebla and the others will harness the River Trefacio, Puebla falls, Aniá de Te falls, Puente de Tera falls near Vigo and Villar de Farton falls.

It is also reported (in *Metalurgia y Electricidad*) that the same company has been authorised to proceed with the establishment of a new transformer station at its generating station on the River Esla near Muelas de Pan. The equipment will comprise three 13·2/46-kV single-phase transformers with a total capacity of 10,000 kVA. A transmission line is to be erected between the Esla station and Villa-camps.

TRANSPORT

Blackpool.—DEVELOPMENT AFTER THE WAR.—Reporting on Blackpool's post-war transport development programme, Mr. W. Luff, transport manager, visualises "a great holiday revival" and estimates that capital expenditure on the municipal transport undertaking in the early peace years will be £805,000. This includes £175,000 for 25 trolley-buses; £100,000 for depot alterations and extensions; £100,000 for permanent way renewals; and £120,000 for 30 new tramcars. If light industries are diverted to Blackpool, it is probable the transport system will be developed on a large scale. Mr. Luff advocates larger and wider trams, with wireless contact with the depot, and trolley-buses for the Marton route.

Darlington.—LOAN FOR TROLLEY-BUSES.—The Finance Committee has approved a proposal to apply for sanction to borrow £20,650 for the purchase of eight trolley-buses.

Russia.—NEW "METRO" STATIONS.—The *Soviet Monitor* reports that two new stations have been opened on the Metropolitan Railway (Underground) line linking central Moscow with the Stalin Automobile Plant, which was inaugurated early this year.

South Shields.—POST-WAR PLANS.—The transport manager is to report on the post-war development of the transport undertaking. It is proposed to change over the system from trams to trolley-buses, which already operate on a number of routes.

RADIO & TELEPHONY

Salford.—POLICE RADIO.—The Watch Committee is seeking sanction to borrow £3,000 for the provision of ultra-high-frequency radio communication equipment for the police.

Switzerland.—ZURICH TELEPHONE SYSTEM.—Last year 5,520 km. of cable was added to the telephone system of Zurich, bringing it up to a total of 316,050 m. The number of telephone subscribers rose from 49,426 to 52,710, equal to one subscriber for every seven inhabitants, including children.—*Reuter's Trade Service.*

Chimney Losses

Checking the Composition of Flue Gases

By "Mechanolectric"

IN order to minimise chimney losses as represented by unnecessary excess air, the highest practicable CO_2 together with the lowest final waste gas temperature must be maintained. How serious these losses may be is shown by the accompanying nomogram (fig. 1); the increased fan loads should be noted. Final flue gas temperatures would be taken care of in the original design and by general routine cleaning. The figures on the nomogram give what may be considered normal operation results.

The CO_2 and CO indicators and recorders should be watched as carefully as the steam and water gauges. They should be capable

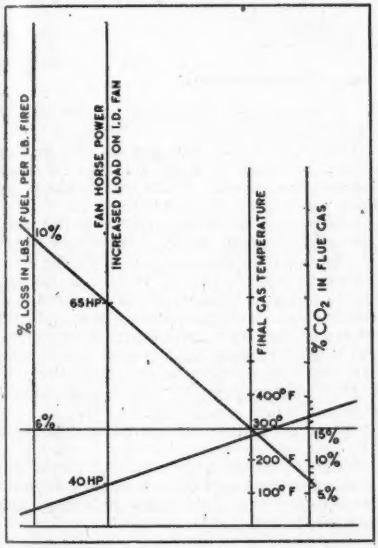


Fig. 1.—Nomogram of chimney losses and fan loads

of connection to the induced-draught fan inlet by a coupling header as well as to the boiler outlet as a means of comparison. They should, together with the draught controls, be in a convenient position for the fireman.

Present-day CO_2 indicators give most reliable and consistent results and records, provided they are kept under regular and intelligent supervision by a combustion engineer, whose duty it should be to see that all instruments are maintained and kept in regular service. The cost of such attention is amply repaid in coal savings. These instruments require checking at intervals by a special member of the staff, who would use a carefully maintained portable instrument.

The combustion engineer should see that a complete outfit for the analysis of flue gases is kept in proper working order. The kit for gas analysis should consist of a portable instrument, absorbent liquids, aspirator and rubber tubing for connections, all of which must be kept clean and carefully stored away when not in use. Glass cocks should be removed, cleaned and greased with a little vaseline, particularly if the absorbent has been in contact with them during use.

Absorbent Solutions

Liquid absorbents should be clearly marked for the purpose for which they are intended. For an Orsat equipment these are as follows:—For CO_2 absorption, potassium hydroxide containing about 17 per cent. by weight of K_2O, or 25 per cent. solution of caustic potash in water; for O_2 absorption, potassium pyrogallate solution containing 14·2 per cent. by weight of K_2O, or 10 gm. of pyrogallic acid in 25 c.c. of water; one volume of the acid is required to five volumes, exactly, of caustic potash solution; the mixture, which will absorb twice its own volume, should be kept in dark storage. For CO absorption, ammoniacal cuprous chloride solution with copper of 150 gm. ammonium chloride in 450 c.c. of water; add 120 gm. of cuprous chloride and stir until dissolved; add ammonia until (and only until) white precipitate almost disappears; the resultant liquid should not smell of ammonia.

In carrying out a test the position from which the gas is taken should be carefully chosen so that the sample is as representative as possible, bearing in mind the possibility of its being drawn into the test instrument against a high negative pressure, dependent on the induced-draught conditions. One should be able to connect up to the piping without disturbing the permanent instrument or its connections or putting it out of commission during the check. The permanent extraction pump might be arranged to assist in obtaining the gas sample, using the existing filter and piping, which of course must be kept clean.

The sample can be taken from the per-

manent pump discharge, if this has a suitable point of connection. Otherwise a tapping point can be fairly easily fitted, to which the rubber connection for the aspirator can be joined. With the test instrument (fig. 2) connected in a convenient position where light is good, readings can be taken. The number of pipettes in the most convenient size is usually three, if hydrogen tests are not required, and these are closed with small flexible rubber pockets or sealed with oil, particularly the tubes containing the cuprous - chloride and pyrogallic solutions as these are affected by atmospheric contact.

The burette or measuring tube for the sample is scaled for accurate measurement of 100 c.c. of sample gas before the absorption process commences. It is surrounded by a water jacket, which should be kept full, to reduce possible atmospheric-temperature, interference with the volume of gas being measured.

The bottom of the burette is connected by a rubber tube to a levelling bottle B, which is kept about two-thirds full of water when at the lower level, its purpose being to control the gas movement for aspiration and gas washing during absorption. The pipettes are rather more than half-filled with liquids. When the individual tests for the different gases are being made, these liquids are drawn to their capillary necks by opening in turn the connecting plug cocks, h1, h2, h3, using the levelling bottle to give this condition.

Testing Gas Sample

A sample of gas can now be drawn into the burette, which is filled with water by raising the levelling bottle to B1. The tap k is opened to receive the gas sample, using the hand aspirator if necessary. The sample is drawn into the measuring burette to a point below the 100 c.c. mark by lowering the levelling bottle. Any excess can be allowed to escape to atmosphere through the three-way cock, k, thus also correcting the gas pressure in the burette.

With the gas sample correctly measured the absorption is begun by opening h1. The gas can be brought into contact with the absorbent by raising and lowering the levelling bottle several times, the gas alternating from pipette to burette. The liquid in h1 is then levelled to its previous point in the capillary neck and the plug cock is closed. The reading of the CO_2 absorbed is taken by raising the levelling bottle till its contents are at the same line as the water in the burette. The decrease in the volume of the sample gas is read off on the scale as a percentage of the CO_2 absorbed.

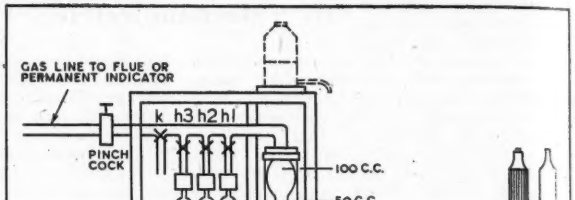


Fig. 2.—Test instrument.

This washing of the gas in the burette should be repeated a second time to check the scale readings. If the two readings are alike, absorption is complete.

The procedure is repeated with the same gas sample taking the O_2 absorption in the h2 pipette, then following on with the same remaining sample in the h3 pipette for any CO that may be present. Each set of readings having been recorded during the tests the results in c.c. may appear as:—Sample gas, 100 (initial reading adjusted to zero); after CO_2 absorption, 14; after O_2 absorption, 20; after CO absorption, 21. Hence, by volume, the percentages are:—CO_2, 14; O_2 (20−14), 6; CO (21−20), 1; nitrogen (by difference) 79.

With the above check on the permanent instrument the plant can be operated with a minimum of excess air and with a minimum load on the fans.

Lighting Data

COST comparisons and other useful information are to be found in B.T.H. Lighting Bulletin (No. 4) which deals with some of the technical and economic aspects of "lighting for production," including worked-out examples of the necessity of considering illumination costs in relation to other production costs. Another bulletin (No. 5) is concerned with practical aspects of lighting with the "Mazda" 80-W fluorescent lamp. Both publications are adaptations of papers read before local groups of the Illuminating Engineering Society.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

Crompton Parkinson, Ltd.—The accounts for the year ended September 30th show a profit of £431,413, as compared with £410,498 for the previous year. The directors recommend a final dividend on the ordinary and "A" ordinary stock of 7½ per cent., making 15 per cent. for the year (same), and a special cash bonus of 7½ per cent. (5 per cent.) on the ordinary and "A" ordinary stock. It is furthur recommended that £5,000 shall be paid to the trustees of the Central Benevolent Fund. There remains £486,657 (£369,744) to be carried forward.

The British Electric Transformer Co., Ltd., reports a profit for the year ended September 30th of £36,999, compared with £41,325 for the preceding twelve months. A final dividend of 6d. per share actual (same) on the ordinary shares will make a distribution of 2s. 4½d. (1s. 6d.) for the year. This allocation, together with the sum of £8,082 special depreciation applied in reduction of plant, machinery, etc., values, will absorb £27,613, leaving the sum of £142 to be carried forward.

The Perak River Hydro-Electric Power Co., Ltd.—At the annual general meeting on November 30th, Mr. William Shearer (chairman) said that in common with other British undertakings trading in Malaya they had had no information as to the present condition of the company's properties. Payments of interest and sinking fund on the 5 per cent. stock guaranteed by the Treasury had been made up to the end of July last and the authorities had indicated that without prejudice to the question of providing the sinking fund appropriations the company must at least meet the interest up to January 31st next. After that payment the cash in hand would be equivalent to a little over one further year's service of the debenture stock and, unless they were relieved of this liability, they would face the reoccupation of Malaya with no funds available, even for immediate repairs to plant. On the other hand, it had been pointed out that when Malaya had been reoccupied the then administration was likely to be ready to discuss problems of electrical reconstruction and they still hoped that an adequate scheme for financial reparation might be evolved.

Joseph Lucas, Ltd.—At the company's annual meeting on Monday Sir Peter F. Bennett (chairman) said that war production to-day was their routine task and the conditions of peacetime production tended to fade from memory. Customers had not to be sought and products were not sold on intrinsic merit in a competitive market, but to Government specification. Whilst every endeavour was made to maintain proper economy of production, nevertheless, the very nature of the tasks, the necessary changes in programme, and the whole atmosphere that surrounded control and direction from outside, resulted in a loss of efficiency as compared with normal business enterprise. For an engineering organisation such as theirs this state of affairs was likely to have prospective dangerous reactions unless it was constantly kept in mind that war conditions were definitely not a pattern for peace.

By the change over to war products they had gained technical experience which would stand them in good stead in the years to come. With regard to peacetime production, it might be stated that they looked for their future in the markets in which they were interested before the war; they had no intention of diverting their interests to fields in which they had neither background nor experience.

Burco, Ltd., reports that the profit for the year ended September 30th amounted to £32,208, as compared with £68,502 for 1941-42, to which is added interest on investments £527 (£648), making £32,735 (£69,150). After meeting depreciation, taxation, etc., and adding £16,043 brought forward, the amount available for appropriation is £39,114 (£39,418). Special depreciation of machine tools takes £2,000 (£3,000), post-war rehabilitation reserve £2,500 (£7,500), and general reserve £5,000 (same). A dividend of 15 per cent., plus a bonus of 2½ per cent., is to be paid, as against 15 per cent., and £20,426 is carried forward.

In a statement accompanying the report Mr. Harry Buckley, chairman and joint managing director, draws attention to the fact that, while the net profit is very little different from last year's there has been a sharp fall in the trading profit. This decrease is due to a reduction both in the volume of work undertaken and in the rate of profit permitted. Secondly, there has been a substantial reduction in the volume of trading allowed in the company's products, on which the profit ratio is higher than on munitions. The manufacture of the company's peacetime products is now practically stopped and it is problematical when sufficient raw material will be forthcoming for a start to be made after the war.

Heenan & Froude, Ltd., record a trading profit for the year ended August 31st of £48,886, as compared with £56,514 in the previous year. Investments and royalties added £738 (£1,356), making £49,624 (£57,780). From this have to be deducted staff fund contribution £3,596 (£4,605), interest and charge £1,374 (£1,897), directors' fees £1,500 (same) and war damage contribution £667 (£1,066), leaving a net profit of £42,487 (£48,718). An interim dividend of 5 per cent. takes £7,500 (£5,625), superannuation fund for female staff £3,388 (nil), tax provision £17,000 (£30,000), a final dividend of 5 per cent. (same) £7,500 (£5,625) and a bonus of 5 per cent. £7,500 (£5,625), and contribution to reserve £625 (£5,000), leaving £7,604 (£8,630) to be carried forward.

The Rangoon Electric Tramway & Supply Co., Ltd., has issued a report covering the two years from January 1st, 1941, to December 31st, 1942. For 1942, traffic, etc., receipts totalled £34,123, as compared with £489,720 in 1941, other receipts amounting to £2,862 (£3,339). Expenses amounted to £88,606 (£372,035), including

operating costs £30,267 (£217,269), evacuation expenses £2,044 (nil), payments to staff on termination of services £20,222 (nil), expenses in India £6,399 (nil), and depreciation and renewals up to March 7th, 1942, £14,500 (£81,000), leaving a loss of £51,621 (profit £101,024).

Dictograph Telephones, Ltd., after providing for E.P.T., show a profit for the year ended August 31st last of £35,005, as compared with £34,266 in the previous year, with a net balance of £14,011 (£15,754). A final dividend of 6 per cent., making 10 per cent. (same), is to be paid and after allocations to general reserve and the employees' fund, £11,782 (£11,771) is carried forward.

J. & F. Stone (Lighting & Radio), Ltd., report a profit for the year ended June 30th of £71,684 (£57,954 in 1941-42). Amortisation of leases, depreciation and directors' fees absorb £10,860 (£10,509), preference redemption £7,039 (£6,931), war damage £617 (£778), taxation £35,000 (£25,000), preference dividend £4,855 (£4,956), and dividend on ordinary capital £12,000 (£10,000), leaving £10,563 (£9,250) to be carried forward. A consolidated balance sheet incorporating S. Grey & Co. (1939), Ltd., and the Chain Store Finance Trust shows current liabilities of £81,609 (£92,866) and floating assets £619,997 (£533,101).

R. & J. Dick, Ltd., show a net profit of £12,492 for the year ended August 31st last. In the previous year the profit was £12,302. The ordinary dividend is to be maintained at 10 per cent., and £10,912 (£10,607) is carried forward.

Bullers, Ltd., have declared a dividend of 5 per cent. for the past year. The distribution for 1941-42 was 7½ per cent.

Lisbon Electric Tramways, Ltd., is paying an interim dividend of 2½ per cent., free of tax, the same as last year.

Thomas de la Rue & Co., Ltd., are paying an interim dividend of 10 per cent. (same).

Lightalloys, Ltd., is paying a final dividend of 12½ per cent. (same), making 25 per cent. (same).

Companies Struck off the Register

The following companies were struck off the Register on November 26th:—Electrical Manufacturing & Plating Co., Ltd., and Short Wave Radio, Ltd.

Companies' Returns

Statements of Capital

Anglo-Argentine Tramways Company, Ltd.—Capital, £11,000,000 in 800,000 1st preference and 710,000 2nd preference shares of £5 each and 862,500 ordinary shares of £4 each. Return dated August 10th. 640,000 1st preference, 610,000 2nd preference and 675,000 ordinary shares taken up. £850,000 paid. £8,100,000 considered as paid. Mortgages and charges: £12,269,714 (including £70,660 annuity).

Crossley Brothers, Ltd.—Capital, £1,492,293 in 201,695 preference and 201,695 preferred ordinary shares of £1 each, and 1,014,014 deferred ordinary and 3,341,598 unclassified shares of 5s. each. Return dated August 30th. 201,695 preference, 201,695 preferred ordinary and 1,014,014 deferred ordinary shares taken up. £326,012 10s. paid. £330,881 considered as paid. £350 paid on 1,400 shares forfeited. Mortgages and charges: Nil.

Kalgoorlie Electric Tramways, Ltd.—Capital, £250,000 in £1 shares. Return dated August 12th. All shares taken up. £250,000 paid. Mortgages and charges: £55,172 13s. and interest accrued on debenture stock since April, 1912.

McMichael Radio, Ltd.—Capital, £250,000 in 150,000 preferred ordinary shares of £1 each and 400,000 ordinary shares of 5s. each. Return dated September 3rd, 1942. 143,788 preferred ordinary and 394,304 ordinary shares taken up. £179,864 paid. £62,500 considered as paid. Mortgages and charges: Nil.

J. Gledson & Co., Ltd.—Capital, £15,000 in £1 shares (5,000 6 per cent. preference and 10,000 ordinary). Return dated September 22nd. All shares taken up. £6,500 paid. £8,500 considered as paid. Mortgages and charges: Nil.

Delhi Electric Supply & Traction Co., Ltd.—Capital, £200,000 in £1 shares. Return dated August 14th. All shares taken up. £121,000 paid. £79,000 considered as paid. Mortgages and charges: Nil.

Public Utilities (Electric), Ltd.—Capital, £25,000 in £1 shares. Return dated September 27th. All shares taken up. £25,000 paid. Mortgages and charges: Nil.

Sydney Hellyar, Ltd.—Capital, £2,000 in £1 shares. Return dated October 14th. All shares taken up. £2,000 considered as paid. Mortgages and charges: Nil.

Argentine Industrial Co., Ltd.—Capital, £200,000 in 200,000 shares of £1 each. Return dated October 28th. 180,007 shares taken up. £7 paid. £180,000 considered as paid. Mortgages and charges: Nil.

Pennington, Stevens & Taylor, Ltd.—Capital, £7,000 in £1 shares. Return dated November 8th. 6,912 shares taken up. £6,762 paid. £150 considered as paid. Mortgages and charges: Nil.

C. J. Bartley & Co., Ltd.—Capital, £1,000 in £1 shares. Return dated August 4th. All shares taken up. £250 paid. £750 considered as paid. Mortgages and charges: Nil.

Winding-up Order

Western Battery & Maintenance Co., Ltd., 57-58, Finsbury Court, Finsbury Pavement, E.C.2.—Winding-up order made November 15th at the High Court of Justice.

Bankruptcies

E. G. Gentle, electrician, 21, Stanley Street, Beaford.—Application for discharge to be heard on January 26th, 1944, at Shire Hall, Bedford.

A. W. Sommer, 6A, Eaton Rise, Ealing, W.5, carrying on business as radio dealer at 20, Belmont Circle, Harrow, Middlesex.—Last day for receiving proofs for dividend, December 15th. Trustee, Mr. L. A. West, Bankruptcy Buildings, Carey Street, London, W.C.2.

STOCKS AND SHARES

TUESDAY EVENING.

STOCK EXCHANGE business has been running again on quiet lines. Markets and their clients are obviously waiting for something of importance to happen in one or other of the war areas. The air is thick with rumour and conjecture. Peace pourparlers are persistently reported to be taking place. Stock Exchange prices and markets are to a large extent affected by these considerations. Prices of shares in the electrical and manufacturing group show a noticeable preponderance of gains over losses.

Home Railway Conditions

Home Railway stocks are out of favour. Investment has no objection to putting money into the prior-charge issues, but steadily declines to take any noticeable interest in the junior stocks. As already mentioned, a movement is on foot for organising the stockholders in the London & North Eastern Railway with the idea of raising fresh protest against the Government's bargain with the companies, with a view, of course, to securing better terms for the latter. Whether or not this will come to anything remains to be proved, but seeing that the increased earnings of the railway companies are due so largely to wartime conditions, it is thought that the chance of the Government varying its bargain with the railways must be remote. Transport "C" is a point lower at 66, but the "A" and "B" stocks have recovered the interest deducted from the prices. Southern 5 per cent. preference advanced to 115. Tillings remain a dull market, the price easing off to 53s. 6d.

Evolution or Revolution?

Prominence has already been given in the *Electrical Review* to the power companies' proposals for modifying the existing structure of the supply industry. The plan provides for improvement of electricity distribution upon an evolutionary basis, and maintains that changes of a revolutionary character are unjustified and unnecessary. When the McGowan Report appeared in 1936, the effect upon the share market at that time was to restore to share prices most of the previous small losses which had been incurred as a result of the uncertainty thought to be facing the electrical industry as a whole. The influence of that report is still seen in the quotations for electricity supply shares. It has had much to do with the steadiness of the market for years past. There has been in the interval an occasional dip in prices, such as that, for instance, which occurred during the time of the heavy raids on London. But, taken as a whole, the market is one of the firmest which the Stock Exchange has provided since the outbreak of war.

The memorandum of the power companies follows more or less closely on the lines laid down by the McGowan report. From the purely Stock Exchange point of view, it can be said that the latest memorandum has had practically no influence on prices of the shares, from which the inference is clear that proprietors of shares in these companies feel too well satisfied with the solidity of their investment for their faith to be shaken by discussion of future possibilities.

Clyde Valley ordinary shares are 6d. up at £2 and Yorkshire Electrics at 41s. 6d. are similarly better. The preference shares in this group are being absorbed by investment that places security before considerations of yield. A fall of 2s. in Perak Hydro-Electric followed upon publication of the company's report and the chairman's statement at last week's meeting.

Price Fluctuations

Consolidated Signal shares are 2s. 6d. down at 5⅛, but Westinghouse Brake shares, the price of which generally moves in correspondence, have risen ⅛ to 3¼. Other shares to gain this fraction are British Insulated, at 106s. 3d., and Murex, at 97s. 6d. Callender's dipped to 97s., and recovered to 98s. Tube Investments at 89s. and Automatic Telephones at 55s. 6d. are 1s. lower. Telegraph Constructions at 50s. have lost 1s. 6d. General Electric, Enfield Cable, English Electric, Associated Electrical Industries, and Ward & Goldstone are amongst those to show advances. De la Rue, after being dull, rallied to 7⅛. The interim dividend is repeated at 10 per cent. A line of ten thousand W. T. Henley's ordinary shares has changed hands at 25s. in two equal amounts. Telephone Rentals and Telephone Properties have hardened to a slight extent. The cable market is steady, with a gain of 1½ points in the 5½ per cent. preference stock to 112½. Foreign affairs happen to be in the limelight: Brazilians are better upon a scheme of arrangement made by Brazil for stabilising her national finances. Brazilian Tractions are ⅛ harder in sympathy with the improvement in the country's bonds.

Crompton Parkinson

Crompton Parkinson make a fine showing in the accounts now presented for the year ended September 30th last. The profit of £431,413 is about £21,000 higher than that of the previous twelvemonth. The final dividend for the year on the ordinary and the "A" ordinary stock is the usual 7½ per cent. but the special cash bonus is raised to 7½ per cent., against 5 per cent. previously. The full dividend for the year, therefore, comes to 22½ per cent. as against 20 per cent. The company has declared a "special bonus"

(*Continued on page* 797)

ELECTRICAL INVESTMENTS

Prices, Dividends and Yields

Company	Dividend Previous	Dividend Last	Middle Price Dec. 7	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies					
Bournemouth and Poole	12½	12½	60/6	..	4 2 8
British Power and Light	6	7	32/-	..	4 7 6
City of London	7	7	28/-	..	5 0 0
Clyde Valley	8	8	40/-	+6d.	4 0 0
County of London	8	8	40/-	..	4 0 0
Edmundsons:					
7% Pref.	7	7	33/6	..	4 3 7
Ord.	6	6	28/-xd	..	4 5 9
Elec.Dis.Yorkshire	9	9	44/-	..	4 1 10
Elec. Fin. and Securities	12½	12½	53/6	..	4 13 4
Elec. Supply Corporation	10	10	46/-	..	4 7 0
Isle of Thanet	Nil	Nil	18/-	..	—
Lancs. Light and Power	7½	7½	34/6	..	4 7 0
Llanelly Elec.	5½	6	25/-	..	4 16 0
Lond.Assoc.Electric	4	3	22/6	..	2 13 4
London Electric	6	6	27/6	..	4 7 3
LondonPowerRed. Deb.	5	5	103½	..	4 16 7
Metropolitan E.S.	8	8	40/-	..	4 0 0
Midland Counties	8	8	38/6	..	4 4 4
Mid. Elec. Power	9	9	42/6	..	4 4 9
Newcastle Elec.	7	7	31/-	..	4 10 5
North Eastern Elec.:					
Ordinary	7	7	32/6	..	4 6 2
7% Pref.	7	7	34/-	+6d.	4 2 4
Northampton	10	10	47/6	..	4 4 0
Notting Hill 6% Pref. (£10)	6	Nil	10	..	—
Northmet Power:					
Ordinary	7	7	37/-	..	3 15 8
6% Pref.	6	6	30/-	+6d.	4 0 0
Richmond Elec.	6	6	26/-	..	4 12 4
Scottish Power	8	8	38/6	..	4 4 4
Southern Areas	5	5	22/6	..	4 9 0
South London	7	7	26/6	..	5 5 8
West Devon	5	5	23/6	..	4 5 0
West Glos.	4½	3½	24/-	..	2 18 4
Yorkshire Elec.	8	8	41/6	+6d.	3 17 3
Overseas Electricity Companies					
Atlas Elec.	Nil	Nil	6/9	..	—
Calcutta Elec.	7*	6*	36/-	..	3 6 8
Cawnpore Elec.	10	10	35/-	..	5 14 3
East African Power	7	7	33/-xd	..	4 4 10
Jerusalem Elec.	7	5	28/-	..	3 11 5
Kalgoorlie (10/-)	5	5	10/-	..	5 0 0
Madras Elec.	4*	Nil	23/-	..	—
Montreal Power	1½	1½	21	+½	7 2 10
Palestine Elec."A"	4*	5*	41/-	..	2 8 10
Perak Hydro-elec.	6	7	10/-	−2/-	—
Shawinigan Power	83cts.	90cts.	15½	−½	—
Tokyo Elec. 6%	6	6	22	..	—
VictoriaFallsPower	15	15	4.4/6	..	3 9 7
Whitehall Inv.Pref.	—	—	25/-	..	4 0 0

Company	Dividend Previous	Dividend Last	Middle Price Dec. 7	Rise or Fall	Yield p.c. £ s. d.
Public Boards					
Central Electricity:					
1955–60 (Civil Defence)	—	3	100	..	3 0 0
1955–75	5	5	114	..	4 7 9
1951–73	4½	4½	106xd	..	4 4 1
1963–93	3½	3½	102	..	3 8 8
1974–94	3½	3½	98½	..	3 6 0
LondonElec.Trans. Ltd.	2½	2½	97	..	2 11 3
London & Home Counties 1955–75	4½	4½	111	..	4 1 1
Lond.Pass.Trans.:					
A	4½	4½	117½xd	+1	3 16 7
B	5	5	117½xd	+1½	4 5 0
C	2½	3	66	−1	4 9 7
WestMidlandsJ.E.A. 1948–68	5	5	109	..	4 11 9
Telegraph and Telephone					
Anglo-Am. Tel.:					
Pref.	6	6	115	..	5 4 4
Def.	1½	1½	27½	..	5 9 1
Anglo-Portuguese	8	8	23/6	..	6 16 2
Cable & Wireless:					
5½ Pref.	5½	5½	112½	+1½	4 17 9
Ord.	4	4	76	..	5 5 3
CanadianMarconi$1	Nil	4cts.	8/6	..	—
Globe Tel. & Tel.:					
Ord.	8¼*	5*	35/6	..	2 16 4
Pref.	6	6	29/3	+3d.	4 2 1
Great NorthernTel. (£10)	Nil	Nil	22½	..	—
Inter. Tel. & Tel.	Nil	Nil	14	..	—
Marconi-Marine	7½	7½	32/3	..	4 13 0
Oriental Tel. Ord.	16	10	43/-	..	—
Telephone Props.	6	Nil	17/-	+6d.	—
Tele.Rentals(5/-)	10	10	11/6	+6d.	4 7 0
Traction and Transport					
Anglo-Arg.Trans.:					
First Pref. (£5)	Nil	Nil	3/-	..	—
4% Inc.	Nil	Nil	8½	−½	—
Brit.Elec.Traction:					
Def. Ord.	45	45	1045	..	4 6 4
Pref. Ord.	8	8	175	..	4 11 5
Bristol Trams	10	10	52/-	..	3 17 0
Brazil Traction	$1	$1⅛	27⅛	+⅛	6 9 0
Calcutta Trams.	5½	6½	37/-	..	3 10 5
Cape Elec. Trams	5	6	24/-	..	5 0 0
Lancs.Transport	10	10	44/3	..	4 10 4
Mexican Light:					
1st Bonds	5	5	106½	..	4 14 0
Rio 5% Bonds	5	5	106½	..	4 14 0
Southern Rly.:					
5% Prefd.	5	5	77½	..	6 9 0
5% Pref.	5	5	115	+1	4 7 0
T. Tilling	10	10	53/6	−6d.	3 14 8
West Riding	10	10	42/6	..	4 14 0

(*Continued on next page*)

* Dividends are paid free of Income Tax.

Company	Dividend Previous	Dividend Last	Middle Price Dec. 7	Rise or Fall	Yield p.c.
Equipment and Manufacturing					
					£ s. d.
Aron. Elec. Ord. .	10	15	55/–	..	5 9 1
Assoc. Elec. :					
Ord.	10	10	48/6	+6d.	4 2 4
Pref.	8	8	38/6	..	4 3 1
AutomaticTel.&Tel.	12½	12½	55/6	–1/–	4 10 0
Babcock & Wilcox	11	11	47/6	–6d.	4 12 5
British Aluminium	10	10	47/3	..	4 4 6
British Insul. Ord.	20	20	5⅛	+⅛	3 15 2
British Thermostat (5/–)	18½	18½	19/–	..	4 17 4
BritishVac.Cleaner (5/–)	15	30	26/6	+6d.	5 13 5
Brush Ord. (5/–)	6	8	8/6	..	4 14 2
Burco (5/–) ..	15	17½	15/6xd	–6d.	5 13 0
Callender's ..	15	20	98/–	..	4 1 8
ChlorideElec.Storage	15	15	80/–xd	+6d.	3 15 0
Cole, E. K. (5/–)	7	10	26/6	+1/–	1 17 6
Consolidated Signal	17	24	5½	–½	4 5 1
Cossor, A. C. (5/–)	7½*	10*	22/3	..	2 5 0
Crabtree (10/–) ..	17½	17½	36/9	..	4 15 3
Crompton Parkinson Ord. (5/–) ..	20	22½	26/6	+6d.	4 5 0
E.M.I. (10/–) ..	6	8	27/6	+6d.	2 18 3
Elec.Construction	10	12½	50/–	..	5 0 0
Enfield Cable Ord.	12½	12½	59/–	+1/–	4 4 9
English Electric..	10	10	46/6	+6d.	4 6 0
EnsignLamps(5/–)	25	25	22/6	..	5 11 1
Ericsson Tel. (5/–)	22*	20*	51/–	..	1 19 3
Ever Ready (5/–)	40	40	38/6	..	5 4 0
Falk Stadelmann	7½	7½	32/–	..	4 13 9
Ferranti Pref. ..	7	7	29/6	..	4 15 0
G.E.C. : Pref.	6½	6½	31/6xd	..	4 2 6
Ord.	17½	17½	87/6	+6d.	4 0 0

Company	Dividend Previous	Dividend Last	Middle Price Dec. 7	Rise or Fall	Yield p.c.
					£ s. d.
Greenwood&Batley	15	15	41/3	..	7 5 9
HallTelephone(10/–)	12½	12½	25/–	..	5 0 0
Henley's (5/–) ..	20	20	25/3	..	3 19 2
4½% Pref. ..	4½	4½	23/–	..	3 18 3
Hopkinsons ..	15	17½	60/–	–⅛	5 16 8
India Rubber Pref.	5½	5½	21/6	..	5 2 4
Intl. Combustion	30	30	6½	..	4 16 0
Johnson & Phillips	15	15	66/6	..	4 10 3
LancashireDynamo	20	22½	92/–	..	4 18 6
Laurence,Scott(5/–)	15	12½	12/6	..	5 0 0
London Elec. Wire	7½	7½	33/–	..	4 11 0
Mather & Platt ..	10	10	51/3	..	3 18 9
Metal Industries(B)	5	8	43/3	..	3 14 0
Met.Elec.CablePref.	5½	5½	21/3	..	5 3 6
Murex	20	20	97/6	+⅛	4 2 2
Pye Deferred (5/–)	25	25	25/–	+⅛	5 0 0
Revo (10/–) ..	17½	17½	40/–	..	4 7 6
Reyrolle ..	12½	12½	70/–	..	3 11 5
Siemens Ord. ..	7½	7½	33/6	..	4 9 7
Strand Elec. (5/–)	7½	10	7/9	..	6 9 0
Switchgear&Cowans (5/–) ..	10	20	18/–	..	5 11 1
T.C.C. (10/–) ..	5	5	18/9	..	2 13 4
T.C. & M. ..	10	10	50/–	–1/6	4 0 0
TelephoneMfg.(5/–)	9	9	11/–xd	–6d.	4 1 10
Thorn Elec. (5/–)	20	20	21/9	..	4 12 0
Tube Investments	20	20	89/–	–1/–	4 10 0
Vactric (5/–) ..	Nil	Nil	14/3	+6d.	—
Veritys (5/–) ..	7½	7½	6/9	..	5 11 1
Vickers (10/–) ..	10	10	17/9	..	5 12 8
WalsallConduits(4/–)	55	55	45/–	..	4 17 9
Ward & Goldstone (5/–)	20	20	27/3	+1/–	3 13 5
WestinghouseBrake	10	12½	65/–	+⅛	3 17 0
West, Allen (5/–)	7½	7½	7/–	..	5 7 2

* Dividends are paid free of Income Tax.

Stocks and Shares (*Continued from page 795*)

each year since 1938. For several years before that, there was a capital bonus; it rose to 100 per cent. in 1935. The company has made remarkable strides since it started operations. In 1932 the profits, allowing for depreciation, were £96,400, not a quarter of the profit just reported, the capital then being much less than now. The price of the 5s. units is 6d. better, 26s. 6d., comparing with 11s. 6d. as the lowest touched over the past five years. To-day's quotation is almost the highest since 1932, when the 5s. units at one time were 32s. 3d.

Radio

Better conditions have obtained in the market for radio shares. It may be that the industrious discussion of peace prospects has something to do with turning the attention of the investor to shares in companies like Electric & Musical, E. K. Cole, Cossor, Pye and others where the scope for after-the-war expansion in their activities is undoubtedly great. From the yield point of view there is, as the Stock Exchange says, nothing in it. Pye shares pay best, at present giving a yield of 5 per cent. on this week's advanced price of 25s. The return on E.M.I. and Cossor is negligible. E. K. Cole is another in this group where the share yield, on the 10 per cent. dividend last paid, is less than 2 per cent. The price of the shares, rising from 25s. 6d., has been up to 27s. from which there was a reaction to 26s. 6d. Optimism looks for a 20 per cent. dividend against the 10 per cent. of a year ago, but even if this expectation is fulfilled, the yield would still be extremely modest. However, people are willing to pay what looks to be an expensive price for post-war prospects, and where there is added the probability of a good dividend increase, as in the case of E. K. Cole, the attraction to buyers seems irresistible.

British Electric Transformer

The British Electric Transformer Co., which is controlled by Crompton Parkinson, in its preliminary statement announced a profit of £37,000 against £41,324. The dividend is maintained at 6d. per share on the ordinary, making 1s. 4½d. for the year, a decline of 1½d. per share. The ordinary are held by Crompton Parkinson and are not marketable, but the company's preference shares change hands on the basis of 22s. 6d.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. each) may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.

BENDIX Aviation Corporation.—" Navigational control devices comprising a directive radio antenna." 6169/42. May 7th, 1941. (557385.)

British Thomson-Houston Co., Ltd.—" Automatic synchronising control systems." 6800/42. May 20th, 1941. (557334.) " Electric motor control systems." 4349/42. April 3rd, 1941. (557354.) " Electric control systems." 4829/42. April 16th, 1941. (557357.) " Electrical circuits for transmitting currents of irregular wave form." 6367/42. May 10th, 1941. (557367.) " Aluminium stearate solutions and process of preparing the same." 15557/41. December 4th, 1940. (557411.) " Electrical regulators for the automatic control of a variable condition or characteristic." 3582/42. March 20th, 1941. (557445.) " Phenol-aldehyde resinous condensates and compositions." 4901/42. April 17th, 1941. (557451.)

Brookhirst Switchgear, Ltd., E. J. Clubbe and R. J. Woods.—" Hinges." 6596. May 15th, 1942. (557372.)

A. Cortella.—" Reproduction of sound and light." 15607. December 3rd, 1941. (557380.)

J. A. Crabtree & Co., Ltd., H. F. McLoughlin, W. E. Hill, H. W. Morgan and T. D. G. Wintle.—" Supports for electric cable." 6416. May 12th, 1942. (557328.) " Electric conduit supports." 6849. May 20th, 1942. (557391.)

Drake & Gorham, Ltd., and J. Newell.—" Supporting arrangements for electric circuit conductors." 6487. May 13th, 1942. (557332.)

E.M.B. Co., Ltd., and L. A. Catlin.—" Injection moulding machines." 10670. July 30th, 1942. (557341.)

English Electric Co., Ltd., G. H. Paulin, F. H. Horner, and L. Berman.—" Speed governing of prime movers." 1786. February 11th, 1942. (557350.)

Evershed & Vignoles, Ltd., and J. C. Needham.—" Electrical indicating instruments and systems." 11967. August 25th, 1942. (557474.)

J. G. Fife (Shell Development Co.).—" Cable oil and insulating material impregnated therewith." 4623. April 8th, 1942. (557321.)

E. Leigh and E. Rotherham.—" Edison-screw lamp extractor and replacer," 12229. August 31st, 1942. (557475.)

W. E. Lord.—" Electric dry cells." 4585. April 8th, 1942. (557356.)

Marconi's Wireless Telegraph Co., Ltd. and G. J. MacDonald.—" Radio reception." 4986. April 15th, 1942. (557362.)

Rediffusion, Ltd. and P. Adorjan.—" Electric wave signalling." 11058. August 7th, 1942. (557440.)

Rediffusion, Ltd. and J. B. M. Clifton.—" Electric control systems employing selectively-operated electromagnetic devices." 6634. May 15th, 1942. (557388.)

Rediffusion, Ltd., G. B. Ringham and P. A. Tiller.—" Screening of electrical devices." 9940. July 17th, 1942. (557469.)

Rotax, Ltd., I. J. Hulbert and P. Tatlow.—" High tension spark ignition apparatus." 6723. May 18th, 1942. (557462.)

L. Satchwell.—" Electric resistance grids." 8876. June 27th, 1942. (557466.)

S. J. Smith.—" Thermostats." 6411. May 12th, 1942. (557327.)

Sodeco Soc. des Compteurs de Genève.—" Prepayment telephone apparatus." 6728/42. May 24th, 1941. (557421.)

Standard Telephones & Cables, Ltd., V. J. Terry and T. F. S. Hargreaves.—" Arrangements for measuring or deriving currents from electrical signal amplitude changes." 4924. April 14th, 1942. (557359.)

R. J. Stevens.—" Circuit arrangements for producing alternating or oscillatory current from a direct current supply." 11336. August 13th, 1942. (557342.)

E. T. J. Tapp.—" Apparatus for electrolytically treating metal." 6370. May 11th, 1942. (557386.)

S. N. Watson and T. Worswick.—" Carrier-wave communication systems." 5158. April 17th, 1942. (557452.)

Whessoe Foundry & Engineering Co., Ltd. and K. W. Francombe.—Electric supply equipment for precipitation plants for industrial gases." 7686. June 5th, 1942. (557336.)

TRADE MARK APPLICATIONS

THE following applications have been made for British Trade Marks. Objections may be entered within a month from December 1st:—

CRESSALL. No. 623,641, Class 9. Electrical resistances; electrical heating elements included in Class 9. No. 623,642, Class 11. Electrical heating elements included in Class 11.—The Cressall Manufacturing Co., Ltd., Eclipse Works, 31 and 32, Tower Street, Birmingham, 19.

Spot Welding

A SPECIFICATION for spot welding light assemblies composed of two or more thicknesses of mild steel (WE/BS.1140) classifies various applications under two broad headings, determined by the relationship between the mechanical strength of the structure and individual welds; the essential features of the types of welding machine for the two classifications are laid down.

The specification defines the chemical composition for the parent metal and includes recommendations as to suitable steels. Mechanical tests are not included as the specification is chiefly concerned with procedure, for which there are appropriate clauses together with requirements for workmanship and inspection. Copies of the new document can be obtained from the British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s. post free.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—QUEENSLAND.—February 11th. Brisbane City Council. Two (or alternatively three) 600-V mercury arc rectifiers, each 1,000 kW rating, together with transformers, high-voltage switchgear, automatic control gear, DC switchgear, supervisory control gear and accessories. Spec. £2 2s. General manager, Department of Transport. (*Tenders*, Melbourne.)

COMMONWEALTH.—January 4th. P.M.G.'s Department. Multiple twin braided cable, Sch. C. 4278. Switchboard keys, Sch. C. 4267.

Long Eaton.—December 11th. Electricity Department. Storage battery. (November 19th.)

New Zealand.—January 31st. Auckland City Council. Electrically driven pumping plant, capacity 8,000,000 gallons per day, for Lower Nihotupu dam.

Plymouth.—January 1st. Electricity Department. Heat insulating material for steam pipework, feedwater pipework, boielr drums and valves. (See this issue.)

Orders Placed

Blackburn.—Electricity Committee. Accepted. 6·6 kV switchgear required to give additional supplies of electricity to Darwen Corporation (£1,766).—Reyrolle.

Manchester. — Electricity Committee. Accepted. Modifications to 33-kV switchgear at substation.—Ferguson, Pailin. Protection of structural steelwork by fire-resistant covering in 33-kV substations.—J. W. Roberts. Switchgear control battery at substation.—Britannia Batteries, Ltd.

Health Committee. Accepted. Electro-convulsion therapy apparatus at Park House.—Edison-Swan. Electrically heated and insulated food conveyor for Crumpsall Hospital.—Mabbott & Co.

Transport Committee. Accepted. Copper cable.—George Taylor (Clayton), Ltd.

Salford.—Light, Heat and Power Committee. Recommended. Automatic control gear (£265).—Hewittic Electric Co.

Sheffield.—Electricity Committee. Accepted. Metering equipment (£2,195).—Ferranti.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ayrshire.—Experimental work in erection of two houses to cost £2,500; architect, County Council offices, Ayr.

Beckenham.—Wartime nursery, Glebe Way, West Wickham; J. Dove, borough engineer, Town Hall, Beckenham.

Bolton.—Canteen and pump house; H. Mason & Sons, Ltd.

Bromsgrove.—Garage, Alvechurch; C. E. Cox, surveyor, Rural Council House, Birmingham Road, Bromsgrove.

Enfield.—Offices, Enfield Cable Works, Millmarsh Lane; M. A. R. Powers.

Fifeshire.—Social and health welfare centre (X-ray equipment, etc.) at Inverkeithing; burgh surveyor.

Guildford.—Restaurants (£1,595); borough engineer.

Hull.—Reconstruction of theatre; Tivoli Theatre Co.

Alterations to Technical College (£5,000); city architect.

Isle of Ely.—Extensions March High School (£4,022); county architect, March.

Isle of Wight.—Alterations and electric lighting, St. Mary's Hospital (£1,474); county architect, Newport, I.O.W.

Jarrow-on-Tyne.—Cinema, York Avenue; T. F. Massicks, Gowland Avenue, Newcastle-on-Tyne, 4.

School kitchen, in Napier Street; borough engineer.

Kettering.—Additions; Wilson & Watson, Ltd., boot manufacturers.

Leeds.—School canteen for 2,000 at Heights Lane, Whingate; W. S. Cameron, city engineer.

London.—PUTNEY.—Extensions; S. A. S. Yeo, Station Chambers, Turnmill Street, London, E.C.1.

STOKE NEWINGTON.—Canteen, 108-116, Albion Road; Howes & Jackman.

Manchester.—Extensions to the Dr. Garrett Memorial Home, Conway; G. Noel Hill, city architect.

Pavilion, restaurant, dining-room, etc., at County Cricket Ground; secretary, Lancashire County Cricket Club, Ltd., Old Trafford, Manchester, 16.

Middleton.—Dairy; J. R. Dickinson, Hopwood Farm, Stakehill Lane.

Central cooking depot; J. Pollard, borough engineer, Town Hall.

Additions, mills; Neva Mills, Ltd., cotton spinners, Grimshaw Lane.

Newcastle-on-Tyne.—Dormitory at Armstrong Road Nursery (£3,564); city architect, 18, Cloth Market.

Pelaw-on-Tyne.—Offices for Bowran & Co., Ltd.; P. L. Browne, Son & Harding, Pearl Buildings, Newcastle-on-Tyne.

Preston.—Church Hall; Rev. T. Cyril Batten, The Vicarage, St. Oswald's Church.

South Shields.—Rebuilding, garage and petrol station; G. W. Smith, Winchester Street.

Sowerby Bridge.—Buildings; H. Peel, Ltd., Canal Mills.

Staffordshire.—Additions to Sandford House Maternity Home, Wordsley; C. M. Coombs, county architect, County Buildings, Stafford.

Stretford.—Store; Redpath, Brown & Co., Ltd.

Sunderland.—New offices for the North-East Fabrication, Ltd.; J. T. Potts & Sons, John Street.

Works extensions; W. & T. R. Milburn, 17, Fawcett Street.

Surrey.—Hutments, Warren Road Hospital site, Guildford; county architect, County Hall, Kingston-on-Thames.

Urmston.—Factory extensions and alterations; Simpson Ready Foods, Ltd., Stretford Road.

Warrington.—Canteens and feeding centres; J. Y. Hughes, Municipal Offices, Bank Park.

West Auckland (Co. Durham).—Factory extensions, West Auckland Trading Estate; E. M. Lawson, Barras Buildings, Barras Bridge, Newcastle-on-Tyne.

West Riding.—Dairy, Scalebor Park, Burley-in-Wharfedale; architect, County Hall, Wakefield.

Willaston.—Village hall; E. B. Lomax, Willaston Hall, near Nantwich.

Wolverhampton.—Hostel, social centre and handicraft school; J. Chamberlain, Wolverhampton, Dudley and District Institution for the Blind.

Wood Green.—Works additions; A. Vernon Watson.

Forthcoming Events

Institution of Electrical Engineers.—*West Wales* (*Swansea*) *Sub-Centre.*—Saturday, December 11th, 3 p.m. Guildhall, Swansea. "Protective Systems for Rural Distribution up to 33 kV," by Messrs. R. W. Steel and W. Allwood.

North-Western Students' Section.—Saturday, December 11th, 2.30 p.m. Engineers' Club, Manchester. "Static Electricity," by Mr. R. Oliver. Thursday, December 16th, 7-11 p.m. Manchester Limited, Cross Street. Christmas dance (tickets 5s.).

Western Centre.—Monday, December 13th, 3 p.m. South Wales Institute of Engineers, Park Place, Cardiff. "Busbar Protection," by Messrs. M. Kaufmann and W. Szwander.

Scottish Centre.—Tuesday, December 14th, 6.15 p.m. Royal Technical College, George Street, Glasgow. Joint meeting with the Institutions of Civil and Mechanical Engineers. "Engineering Economics," by Sir Frank Gill.

North Midland Centre.—Tuesday, December 14th, 6 p.m. Great Northern Hotel, Wellington Street, Leeds. "Standardisation of Single-Circuit Overhead Lines up to 33 kV," by Messrs. H. Willott-Taylor and K. L. May. *Students' Section.*—Saturday, December 11th, 2.30 p.m. Leeds College of Technology. Joint meeting with Graduate Sections of Institutions of Mechanical and Production Engineers. "Inside of Arc Welding" (G.E.C. technicolour film).

London Students' Section.—Wednesday, December 15th, 7 p.m. "Electrical Transmission of Sound," by Mr. K. J. Easton.

South Midland Wireless Group.—Tuesday, December 21st, 6 p.m. James Watt Institute, Birmingham. "Enemy Airborne Radio Equipment," by Mr. C. P. Edwards.

Association of Supervising Electrical Engineers.—Saturday, December 11th, 2.15 p.m. Lighting Service Bureau, Savoy Hill, London, W.C.2. "Converting and Rectifying Plant Problems," by Mr. A. M. Browne.

Birmingham and District Branch.—Saturday, December 11th, 3 p.m. Chamber of Commerce, New Street. "Modern Industrial Installations," by Mr. R. S. Whaley.

Illuminating Engineering Society.—Tuesday, December 14th, 5 p.m. Institution of Mechanical Engineers, London, S.W.1. Joint meeting with the Association of Public Lighting Engineers. Discussion on "Street Lighting Specifications of the Future; Should they be Based on the Design of the Unit or the Effect of Illumination?" to be opened by Dr. S. English and Mr. R. Maxted.

Institute of Fuel.—*Newcastle-on-Tyne.*—Monday, December 13th, 5.15 p.m. Central Station Hotel. "Work of the Fuel Research Board," by Dr. A. Parker.

Birmingham.—Wednesday, December 15th, 2.30 p.m. James Watt Institute. "Use of Low-Grade Fuels for Steam Raising," by Mr. J. Stanley Jones.

British Association of Refrigeration.—Thursday, December 16th, 5.30 p.m. Institution of Mechanical Engineers, London, S.W.1. Discussion on "Domestic Refrigeration."

Association of Mining Electrical and Mechanical Engineers.—*London Branch.*—Thursday, December 16th, 4.30 p.m. 39, Victoria Street, S.W.1. Discussion meeting.

South Wales Branch.—Saturday, December 18th. Cardiff. Informal talk on "Fuel Economies." Mr. E. K. Regan will open the discussion.

Institution of Mechanical Engineers.—Friday, December 17th, 5.30 p.m. Symposium of papers: "Application of Statistical Methods to the Control of Industrial Costs," by Mr. N. R. Neal; "Inspection Efficiency," by Messrs. J. C. Edwards and W. A. Bennett; and "Sampling Schemes for Accept-Reject Inspection," by Mr. A. W. Swan.

North-Eastern Branch.—Monday, December 13th, 6 p.m. Neville Hall, Newcastle-on-Tyne. "Gyroscopic Principles and Applications," by Prof. C. E. Inglis, O.B.E.

Junior Institution of Engineers.—Saturday, December 18th, 2.30 p.m. 39, Victoria Street, London, S.W.1. Presentation of awards and induction of Sir Maurice Denny as president.

Midland Section.—Saturday, December 11th, 2.30 p.m. James Watt Institute, Birmingham. "The Synchrophone as an Aid to Post-War Training," by Mr. N. Sandor.

Electrodepositors' Technical Society.—Monday, December 20th. Northampton Polytechnic, London, E.C.1. "Costing of Electroplating Processes," by Mr. R. W. Harrison.

North-East Coast Institution of Engineers and Shipbuilders.—It is announced that the annual general meeting is not to be held to-day (Friday) as was previously arranged.

1943

y exten-
E. M.
e, New-

Burley-
Wake-

Lomax,

re and
erhamp-
ne Blind.
Vernon

ffect of
English

Tyne.—
Central
Research

er 15th,
Use of
by Mr.

—Thurs-
ution of
1. Dis-

Mechan-
hursday,
a Street,

ecember
" Fuel
pen the

—Friday,
ium of
Methods
Ir. N. R.
srs. J. C.
ampling
on," by

ecember
on-Tyne.
ons," by

aturday,
a Street,
rds and
sident.
ber 11th,
ingham.
ost-War

.—Mon-
n Poly-
Electro-
ison.

eers and
annual
(Friday)